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THREE DIFFERENT MODES OF TEETHING AMONG SELACHIANS.*

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ABOUT two years ago Mr. Orestes St. John came to the Museum of Comparative Zoology with a very large collection of fossil fish teeth, with the intention of identifying them and comparing them with those which we had in our own collections. This became an occasion for me to look over the materials we possess. In former years I had paid considerable attention to the subject and contributed somewhat to the advancement of our knowledge in respect to the peculiarities of teeth among the representatives of the class of Selachians. I soon found that the progress of paleontology and zoology made the present materials on hand quite insufficient for the task. It was not known how constant the characters derived from the teeth among Selachians could be considered to be, or, with few exceptions, what changes took place with age. So I determined upon the voyage of the Hassler

*This paper is printed from a report taken of Professor Agassiz' communication before the "National Academy of Sciences" at its meeting in Cambridge, Nov. 29, 1872. It was the intention of the author to revise the report for publication in the NATURALIST, and he had begun to do so, the first four pages of the manuscript having been corrected during the last two weeks that he was at his museum. The paper can therefore be considered in part as one of the latest efforts of the lamented author, and it must be remembered that he would undoubtedly have made many additions and some changes, had not his fatal sickness taken him from the very midst of his active labors. — EDS.

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to make the collecting of Selachians a principal object of my attention, and to gather specimens in greater number than is usually the case with animals of these large dimensions. I have been richly rewarded for my efforts though it has been at the cost of considerable labor. We now possess in the Museum many thousand specimens of Selachians. I do not suppose there is another collection covering so largely the different stages of growth of these animals. I have examined these specimens one by one and since my return have made a very careful examination of one species in several families, in order to have standards of comparison based upon the study of several hundred specimens for each family.

The result of this examination shows that while in their adult condition the Selachians present characters which are very constant among specimens of the same age, such marked changes take place among them during their growth that even genera have been founded on the difference of age. I wish to show first, that among the adults we have constancy of character. As an example I may take a species of *Odontaspis* of which I have twenty-five adult specimens. I have selected this genus for special study on account of its relations to the fossil species of the tertiary formation. In *Odontaspis* the front teeth are placed as if there were a set of front teeth distinct from the canine teeth, and back of them molar teeth of a very different size, all the specimens exhibiting the same arrangement and even the same number of teeth. This is generally the case with the sharks proper. But when we compare specimens of different ages we find in that respect a great deal of difference. There are some species in which at an early age the adult condition is already established, and where the changes are only in the size of the teeth. There are other genera, on the contrary, in which the young have fewer rows, and rows of different kinds of teeth from those which are developed at a later day. As to the manner in which the changes take place I have noticed three essentially different modes of teething.

One is the ordinary mode of development of the teeth among sharks, in which there is a row of teeth standing erect along the outer margin of the jaws, and behind them as many rows of teeth reclining backwards as there are erect teeth outside. These reclining teeth are in various stages of growth; so that to the erect teeth

functionally used in catching the prey there correspond three, four, five, six or seven immature teeth placed one behind the other in the fold of the gum, the youngest occupying the innermost portion. These teeth come into play one after another as the front teeth drop off. This is the mode of teething among Selachians with which all zoologists are familiar, as it occurs among sharks generally and among our common skates. The jaw of our large barn-door skate, *Raja ocellata*, for instance, exhibits vertical rows of teeth placed one behind the other, as in the sharks, the innermost of which are immature, while those along the outer edge of the jaw are ready to drop. Some of these teeth may be so slightly attached to the gum that they drop readily, while others are so connected with the jaw that they serve their purpose for a longer time. Now in Selachians which have this mode of teething the teeth begin to show themselves rather late in life. The embryos of these sharks and skates do not have teeth, and even after birth the young show very imperfect or rudimentary teeth. In some of them, after being for some time in the water and providing for their own food, the teeth are so imperfectly developed that no row is visible along the edge of the jaw; but when the teeth rise to the margin of the jaw their number is already fixed and the young teeth are formed in rows behind those of the outer series. From that time no other change takes place except that larger and larger teeth are formed behind the old ones as these drop in succession; and as the old ones drop the next oldest come into play and so on.

In *Galeocerdo*, a genus of much interest to paleontologists, the teeth are very uniform in both jaws and more nearly of the same size than in other families, while the teeth which are to replace the old ones are not much larger, thus showing that these sharks grow very slowly. These facts are very important with reference to the identification of the fossil species. In younger specimens of this genus there are fewer rows of replacement teeth and they resemble adult teeth much less than they do here. As the jaw enlarges with age, the new sets of teeth enlarge also, and in that manner the whole margin is always occupied by teeth.

In *Cestracion*, on the contrary (and under this name I designate the Port Jackson shark and not the hammer-heads), we have a totally different mode of teething, the knowledge of which is essential to a correct appreciation of the zoological value of a vast number of fossil teeth characteristic of the older and middle ge-

ological formations. I have been fortunate enough to secure a large number of specimens of the *Cestracion* living along the coasts of California, Peru and the Galapagos Islands. I have those of Australia also in various stages of growth, so that I could ascertain the mode of dentition of the genus by a comparison of different species. In the adult, as is well known, the front teeth are pointed, while the lateral teeth are grinders, and there are grinders with flat surfaces and grinders of different forms, in the middle of the jaw and behind. What is particularly characteristic of these fishes is that the teeth rest upon the surface of the jaw, forming flat expanses for chewing, and that many teeth are at work at the same time; also that the inner part only of the rows is in progress of formation, while a great many rows act at the same time.

In this condition, the genus *Cestracion* has been described, and it is generally understood that what distinguishes it is the presence of these different kinds of teeth; but when I had an opportunity to examine the younger ones, I found that there were none of those peculiar teeth in the back part of the jaw. Young that swim about in search of prey exhibit only the conical teeth at the anterior part of the jaw and have none of the teeth with flat surfaces at the hinder part of the jaw. What is still more striking is that these front teeth, corresponding to the front teeth of the adult, have not single points as in the adult but two lateral prongs. The teeth which are behind are gradually reduced to three prongs, and finally only one prong with a little hook on the side, and in very old specimens even these little prongs at the side are wanting; so that you have a succession of different teeth resulting from the gradual change in the teeth of the same series. The first teeth of the young have this complicated character which is maintained through successive droppings before the teeth of another character come in. These remain for a time again until a third type of teeth is brought in. As these changes go on in the front we find that row after row is added behind, so that the number of rows covering the surface of the jaw is gradually increased.

We see in this a different arrangement from the other sharks, in which the total number of teeth in the jaw is early established and remains the same for life, while here the number of rows increases and the rows forming behind have a totally different

character from those in front. The front teeth in these rows constantly drop and give place to others. This implies a functional differentiation which is marvellous. Mark that every tooth that replaces another has a different character from the previous one. We have here opportunities for variation, for changes, for transmutation, to an extent which has not been noticed in any other family of animals as far as I know.

Let me here say that from single specimens of *Cestracion*s, obtained in different parts of the world, have been indicated three supposed genera based on the conditions of the teeth at different periods of age.

To show that this should not be accepted as an unquestionable result, let me say that I have examined the young of the three supposed genera. They are all provided with keeled molar teeth, while the adults have the flat grinders supposed to be characteristic of the *Cestracion* type alone. I am therefore satisfied that it is worth while to collect largely and preserve a number of specimens, even if they be sharks and skates and occupy a great deal of room, in order to learn their history, which has shown of just what importance has been the identification of teeth among fossils. Thus sharks drop their teeth and scatter them along the bed of the ocean in great numbers, probably ten or twenty times as many as they have at one time while living, so that it is not to be wondered at that we so frequently find in collections of fossils loose teeth of sharks, and that we so rarely find the jaws of sharks with teeth in their places.

Of course in those species in which the teeth are isolated and do not support one another, we should hardly ever expect to find them fossil in position; while those which are pressed upon one another may be found in the fossil state, and that occurs again and again, and among the fossil fishes there are a number of sharks in which jaws with teeth arranged in rows are represented.

There is a third mode of teething as different from the other two as these two are different from one another. It occurs in the family of *Myliobatidæ* among the skates. In *Myliobatis*, as generally known in the mature condition, we have a middle row of broad and short teeth; along the margin are a number of rows of smaller teeth, and it is known that in front these teeth drop and are replaced from behind. For a long time I could not under-

stand how teeth of a large size could follow the teeth of very small dimensions which exist in the young. In the teeth of the young taken from the mother, embryos therefore, and not young in the ordinary sense, the whole width of the dentary portion of the jaw is not half the width of the central tooth of an adult, but on careful examination it will be seen that the hind part of these teeth is not as broad as the front part. They form in fact cones, and of course a cone long enough will bring to the front part very small teeth. Teeth as small as a pin's head are actually found in the jaw. I have examined a number of jaws of *Myliobatis*, all of which show that fifty times as many teeth must have been dropped as remain in the jaw. The teeth are not pushed sideways: they are pushed forward. This occurs in *Myliobatis*, where we have a number of teeth varying from a single one in the centre of the jaw, to four rows on each side and a middle row in addition, all of which progress from behind forward. In the genus *Ætobatis* the teeth are conical, the front part being much narrower than the hind part.

The introduction of the new kind of teeth is a complicated thing to explain, and to state the changes which they undergo by age would occupy too much time. Let me say only, that besides these principal modes of teething we have some modifications of them which are characteristic of particular families. In the ordinary skates (*Raja*) the rows of teeth are disconnected from one another and run from the margin inward in unbroken continuity. In the sting-rays (*Trygon*) and all the representatives of that family, they cover the jaw closely and are quincuncially arranged. That is, while in the common skates the rows are nearly straight, in the sting-rays there are border rows and between them other rows, so that the whole surface of the jaw is covered with teeth. It is as if the teeth of the common skate had been brought together and crowded, so that one row was pressed into the space of another; the teeth do not drop singly but are brought forward like a pavement, the margin of which is gradually dropping.

There is another modification characteristic of the dog-fish (*Acanthias*) in which the teeth of the successive rows overlap one another from the side; not uniformly from both sides but from one side; so that one tooth overlaps the other tooth, and so on, as if they had been squeezed from the side and made to pass over the next tooth in that way.

If from the living sharks we pass to the fossils, we have still other modes of teething. We find in some of them instead of distinct teeth plates covering the jaw, only three plates on each half of each jaw. These plates are conical; that is, pointed along the margin and broader inward. The teeth increase by curving the point over the jaw while the inner margin is gradually enlarging. The triangular pointing of the teeth accounts for the increased dimensions of the teeth from the young to the adult.

We have one further step where the teeth, instead of being only laid down on the surface of the jaw, are actually incorporated with it, so soldered with it that between the jaw and teeth there is hardly any difference recognizable.

THE WILD CATTLE OF SCOTLAND, OR WHITE FOREST BREED.

BY E. LEWIS STURTEVANT.

ACCORDING to our best authorities two forms of the ox tribe, the genus *Bos*, existed in Scotland at an early period, *Bos primigenius* and *B. longifrons* of Owen. The former was of large size, and according to all accounts the color was black; it had white horns with long black points, the hide was covered with hair shorter and smoother than in the tame ox, but on the forehead long and curly. From the skeletons preserved in our museums the length of this gigantic ox must have been from eleven and one-half to twelve feet, and the height at the shoulders about six or six and one-half feet.* Darwin remarks that the Pembroke race in England closely resembles this ox in essential structure, and that the cattle at present existing in the Chillingham Park are degenerate descendants of this breed.† *Bos longifrons*, on the contrary, is described as a distinct species, of small size, short body and fine legs. It was domesticated in England during the Roman period.‡ Professor Owen thinks it probable that the Welsh and Highland cattle were descended from this species.§

* Nilsson, *Annals and Mag. of Nat. Hist.*, 1849, iv, 258.

† *Animals and Plants under Domestication*, i, 103.

‡ *British Pleistocene Mammalia*, p. xv.

§ *Animals and Plants under Dom.*, i, 104.

A continuous range of enormous forests covered the whole extent of the country in prehistoric times, while the gigantic and fierce cattle roamed through the chase,* and fed on the tender branches and buds, the catkins of birch, hazel, willow, and other species of willow,† resembling in this matter of feeding the moose of the Canadian forests. We have reason to suppose that the ancient islanders introduced the rudiments of a pastoral life, while yet living in pits inclosed with boughs and skins,‡ yet no evidence leads to the conclusion that the native Britons had domesticated the great oxen of the country, although undoubtedly they formed a source of food.§ In Switzerland, on the contrary, the lake dwellers had succeeded in taming these formidable brutes.||

We have it stated by Darwin, that *Bos primigenius* existed as a wild animal in Cæsar's time.¶ There is a record of white cattle in the tenth century, resembling those in the Scottish parks, existing in Wales, where they were more valued than black cattle.** Boethius, in 1526, mentions them as then existing near Stirling. "At this toun began the grit wod of Calidon. This wod of Calidon ran fra Striveling throw Menteith and Stratherne to Atholl and Lochquabir, as Ptolome writtis in his first table. In this wod wes sum time quhit bullis, with crisp and curland mane, like feirs lionis, and thought thay semit meek and tame in the remanent figure of thair bodyis, thay wer mair wild than ony uthir beistis, and had sic hatrent aganis the societe and cumpany of men that thay come nevir in the wodis, nor lesuris quhair thay fand ony feit or haind thairof, any mony dayis eftir, thay eit nocht of the herbis that wer twichit or handillit be men. Thir bullis wer sa wild, that thay wer nevir tane but slight and crafty laubour, and sa impacient that eftir thair taking they deit for importable doloure. Also sone as ony man invadit thir bullis, they ruschit with so terrible preis on him, that they dang him to the eird, takand na feir of houndis, scharp lancis, nor uthir maist penetrive wapinnis." "And thought thir bullis were bred in sindry boundis of the Calidon wod, now, be continwal hunting and lust of insolent men, thay are distroyit in all partis of Scotland, and nane of thaim left bot allanerlie in

* Prehistoric Scotland. Wilson's. † Nilsson, An. & Mag. of Nat. Hist., 1849, iv, 269.

‡ Prehistoric Scotland, i, 296. § Prehistoric Scotland, i, 31.

|| Lyell's Antiq. of Man. Phila., 1863. p. 24.

¶ Animals and Plants under Domestication, i, 104. ** Low's Animals, 239.

Cumarnauld.”* In a remarkable document, written about 1570, the writer complains of the aggressions of the King’s party in the destruction of the deer in the forest of Cumbarnauld, “and the quhit ky and bullis of the said forest, to the gryt destructione of policie and hinder of the commonweill. For that kynd of ky and bullis he bein keptit thir money zeiris in the said forest, and the like was not mantenit in ony vther partis of the Ile of Albion.”† In 1598, John Leslie, Bishop of Ross, speaks of the wild ox occurring in the woods of Scotland, of a white color, with a thick mane, resembling a lion’s, and wild and savage. He says that it had formerly abounded in the Sylva Caledonia, but was then only to be found at Stirling, Cumbarnauld, and Kincardine.‡ Sandford, in his manuscript history of Cumberland, dated 1675, says around Naworth formerly were “pleasant woods and gardens; ground full of fallow deer, fieding on all somer-tyme; brawe venison pasties, and great store of reid deer on the mountains; and white wild cattle, with black ears, only on the moores.”§ We find them referred to by Bewick, in 1770, and in 1781 Pennant speaks of them as retaining their white color, but as having lost their manes. || Conrad Gesner describes them as “white oxen, maned about the neck like a lion. . . . This beast is so hateful and fearful of mankind, that it will not feed of that grasse or those hearbes whereof he savoureth a man hath touched—no, not for many days together; and if, by art or policy, they happen to be taken alive, they will die with very sudden grief. If they meet a man, presently they make force at him, fearing neither dogs, spears, nor other weapons.” (16th century; quoted from Scherer’s *Rural Life*, p. 627.)

“Here (Cadzow Castle), so late as the year 1760, were a few of those white cattle with black or brown ears and muzzles, once so common in Scotland. Their shyness and ferocity of temper rendered them troublesome and of little use, they were therefore exterminated in the year above mentioned.” (*The History of the City of Glasgow, etc.*, by James Denholm Glasgow, 1798, p. 252.)

* Hector Bosce, born in 1470. *Hist. Scotorum*, pub. at Paris, 1526, ed. of 1574, fol. 6, line 63, occurs the passage quoted in *An. & Mag. of Nat. Hist.*, 1839, ii, 281, and *Low’s Animals*, 234.

† Illustrations of Scottish History, preserved from manuscripts by Sir John Graham Dalyell, Bart., quoted in *Low’s Animals*, p. 235.

‡ Leslie. *De Origine Moribus et Rebus Gestis Scotorum*. Rome, 1598, ed. of 1675, 18, quoted in *An. & Mag. of Nat. Hist.*, 1839, ii, 282. Also in *Low’s Animals*, 234.

§ *Jour. R. A. S.*, 1852, xiii, 249. || *Quadrupeds*, 16.

About 1800 they are spoken of as invariably white, with the ears internally, and externally about one-third down, red; horns white, tipped with black, and the muzzles black.* In 1836, we begin to get more particular descriptions. Color invariably white, muzzle black, the whole of the inside of the ear, and about one-third of the outside, from the tip downward, red. The horns are very fine, white with black tips; and the head and legs are slender and elegant.† The Earl of Tankerville, the proprietor of Chillingham park, describes them in 1839. In form they are beautifully shaped, with short legs, straight back, horns of a very fine texture, as also their skin so that some of the bulls appear of a cream color.‡ In 1845, Low says that the eyelashes and tips of the horns are black, the muzzle brown, the inside and a portion of the external parts of the ears are reddish-brown, and all the rest of the animal white. The bulls have merely the rudiments of manes, consisting of a ridge of coarse hair upon the neck.§ In 1852, William Dickinson says that their bodies are pale cream color, the ear tips red and the muzzle black.|| In 1868, Darwin describes them as white with the inside of the ears reddish-brown, eyes rimmed with black, muzzle brown, hoofs black, and horns white tipped with black.¶ Youatt mentions the existence of a mane on some of the bulls, one and one-half or two inches in length.**

As a wild race we hear of their occurrence at rare intervals. In the time of Edward the Confessor (1042), we are told by one of the abbots of St. Albans that wild bulls abounded near London,†† and Fitz-Stephen writing about 1174, speaks likewise of their occurrence in these woods.‡‡ In 1760, wild white cattle were just extinct in the central Highlands.§§ In 1598, their occurrence in Scotland was confined to but a few localities.|||| We are thus particular in tracing the accounts of this breed, as Wilson maintains that no sufficient evidence has ever been brought forward to prove that these cattle are entitled to the character of an aboriginal breed.¶¶ Of the remnants of this ancient race, we have two herds, at least, existing at the present time, and records of others whose extinction has been comparatively recent. The general

* Complete Grazer, p. i. † Naturalists' Lib., Jardine, iv, 202.

‡ An. & Mag. of Nat. Hist., 1839, ii, 277. § Low's Animals, 237.

|| Jour. R. A. S., 1852, xiii, 249. ¶ An. & Pl. under Dom., 107.

** Youatt & Martin on Cattle, 12. †† An. & Mag. Nat. Hist., 1st ser., iii, 356.

‡‡ An. & Mag. Nat. Hist., 1849, iv, 423. §§ Trans. H. & Ag. Soc., 4th series, v, 294.

|||| Low's Animals, 234. ¶¶ Enc. Brit., xiv, 214.

descriptions of white with colored ears apply to all, yet each herd has had its distinctive features, and we find evidence of a constant tendency to variation, only repressed by a rigorous selection.

Chillingham castle, the seat of the Earl of Tankerville, is situated in Northumberland County, England, and formerly occupied one end of the Caledonian forest, which in former times extended from sea to sea. The wild cattle have been preserved in this park with care, and kept free from intermixture with other breeds. They have been extensively inbred from necessity, "and are accordingly much subject to rash, a complaint common to animals bred in and in." We find it recorded that the stock at Chillingham was at one time left without a bull, from accident and sterility. Fortunately one of the cows had a bull calf, and the stock was preserved.* In color, they are invariably white† or white,‡ or pale cream color§ or creamy white.|| or white and cream color.¶ Their horns are white tipped with black; their muzzle black** or brown;†† their eyelashes black;‡‡ their eyes rimmed with black.§§ Their ears inwardly and about one-third externally, red,||| reddish-brown,¶¶ or red or brown.*** Their necks have rudimentary manes,††† or oftentimes a mane from one and a half to two inches long,‡‡‡ or no manes but coarse hair.§§§ Their heads slender,|||| backs straight. Legs short¶¶¶ and slender,**** and the hoofs black.††††

In 1675, as we have seen, they are described with black ears.‡‡‡‡ In 1770 according to Bewick, some calves appeared with black ears, but these were destroyed, and black ears had not since reappeared.§§§§ Since 1855 about a dozen calves have been born with brown or blue spots on their cheeks or necks, but these, with any

* Earl of Tankerville, *Annals and Mag. of Nat. Hist.*, 1839, ii, 284. *Nat. Lib., Jardine*, iv, 207, note.

† *Nat. Lib., Jardine*, iv, 202, note. ‡ Darwin, *An. & Pl.*, under *Dom.*, i, 107.

§ Hindmarsh, *An. & Mag. Nat. Hist.*, 1839, ii, 279. Dickinson, *Jour. R. A. S. of Eng.*, 1852, 249.

|| Capt. Davy, *Milk Journal*, Oct., 2, 1871, 225.

¶ Earl of Tankerville, *Annals of Nat. Hist.*, 1839, ii, 277.

** Dickinson, *Nat. Lib.*, Capt. Davy, *op. cit.*

†† Low, Darwin, Earl of Tankerville, *op. cit.*

‡‡ Low, Hindmarsh, *op. cit.* §§ Hindmarsh, Darwin, *op. cit.*

||| Dickinson, *Nat. Lib.*, *op. cit.* ¶¶ Low, Darwin, *op. cit.*

*** Earl of Tankerville, *Annals of Nat. Hist.*, 1839, ii, 277.

††† Low's *Animals*, p. 237. ‡‡‡ Youatt and Martin on *Cattle*, p. 12.

§§§ Earl of Tankerville, *An. of Nat. Hist.*, 1839, ii, 277.

|||| Earl of Tankerville, *An. of Nat. Hist.*, 1839, ii, 284.

¶¶¶ Earl of Tankerville, *An. of Nat. Hist.*, 1839, ii, 277.

**** *Nat. Lib., Jardine*, iv, 202, note. ††† Darwin, *An. & Pl. under Dom.*, i, 107.

†††† *Jour. R. A. S.*, 1852, xiii, 249. §§§§ Darwin, *An. and Pl. under Dom.*, i, 107.

other defective animals, were immediately destroyed,* and Low speaks of the tendency of the young to be altogether black or altogether white, or to have black ears.† In Knox's "Natural History," published probably in the earlier part of the present century, these cattle are said to have lost their manes, but to have retained their color and fierceness; to be of a middle size, long legged, with black muzzles and ears, and their horns to be fine and to have a bold and elegant bend. The keeper of those at Chillingham said that the weight of the ox was thirty-eight stone, of the cow twenty-eight. It would thus seem as if Knox spoke from personal observation (vol. i, p. 55).

The Hamilton Park cattle are often referred to as the cattle of the Chase of Cadzow, after the castle of that name, the former seat of the dukes of Hamilton. Cadzow Castle occupies a site on the banks of the Avon in Lanarkshire, at one extremity of the ancient Caledonian wood. Aiton, in 1814, describes these cattle as uniformly of a creamy white color, their muzzles and the greater part of their ears black or brown, and some with a few black spots on their sides. A few are without horns, but the greater number have handsome white ones, with black tips bent like a new moon. Some of the bulls have a sort of mane, four or five inches long. The cattle at Hamilton and Ardrossan are not so fierce and savage as their ancestors, but at Aucheneruive they still retain much of their natural ferocity. Their backs are high and not so straight as could be wished. Their chest is deep but narrow, and they have much the appearance of the ill-fed native breed of the cattle of Ayrshire, Lanarkshire, etc., about fifty years ago.‡ In 1845 Low describes them as with the females generally polled,§ and in 1870 the bulls are credited with black tipped horns.|| Their color is given as dun white,¶ or dingy white,** their muzzle and hoofs black,†† as also the inside of the ears,†† and the tongue.‡‡ In the "Naturalist's Library" we find it stated that their bodies are thick and short, their limbs stouter than the Chillingham breed, and their heads much rounder, the inside of their mouths either black or spotted with black, and the fore part of their legs, from the knee downward, mottled with black.§§ At one time but thirteen re-

* Darwin. An. and Pl. under Dom., i, 107. † Low's Animals, 238.

‡ Sinclair's Scotland, iii. 44. § Low's Animals, 236.

|| Gard. Chron. and Ag. Gaz., Aug. 6, 1870. ¶ Low, Nat. Lib., *op. cit.*

** Dickinson, Jour. R. A. S., of Eng., 1852, 249. †† Low, Nat. Lib., *op. cit.*

‡‡ Low's Animals, 236. §§ Nat. Lib., Jardine, iv, 202, note.

mained alive, the survivors of the cattle plague of the few years previous. The bulls looked as if they might fatten to eight hundred or eight hundred and fifty pounds. They had light hind quarters but were heavy and deep in front; all had black muzzles, black ears, and the older beasts black tips to their horns.* We were told that some years ago the herd numbered eighty or ninety, but all fell victims to the cattle plague, except thirteen, of which eleven altogether escaped and two recovered. When the plague attacked them, they were driven individually between gradually approaching fences, leading to a large and strong wagon sunk to the ground level, and so captured, and taken to separate abodes, where they were confined until all risk was passed. They have now (in 1870) increased to thirty-seven.†

We have mention of some having been kept at Ardrossan and Auchencruive, but no further particulars, except that those at the latter place were very fierce.‡ They were also kept at Bishop-Auckland in 1635.§

The cattle preserved at Drumlanrig, the seat of the Duke of Queensberry, are said by Darwin to have become extinct in 1780, and are described as with their ears, muzzle and orbits of the eyes black.|| Pennant writing in 1781 speaks of them as still existing, having lost their manes, but of a white color.¶ Dickinson states that two cows and a bull were living in 1821, but the bull and one of the cows died that year. He describes them as dun or rather flea-bitten white, polled, with black muzzles and ear tips, with spotted legs.** Low says they were destroyed many years ago by order of the late Duke of Queensberry.

The cattle at Gisburne Park, in Craven, County of Yorkshire, England, the seat of Lord Ribblesdale, are mentioned, as late as 1852, as being pure white with brown or red ears and noses.†† Low speaks of their being polled,‡‡ and Bewick describes them as perfectly white except the inside of their ears which are brown. They are without horns, very strong boned but not high.§§ He also states, as Darwin quotes, that they are sometimes without

* Gard. Chron. and Ag. Gaz., Aug. 6, 1870. † Gard. Chron. and Ag. Gaz., Aug. 6, 1870.

‡ Sinclair's Scotland. iii, 44. § An. Nat. Hist., vol. iii, ser. 1, p. 241.

|| Darwin, An. and Pl. under. Dom., i, 107. ¶ Quadrupeds, 16.

** Dickinson, Jour. R. A. S. of Eng., 1852, 249.

†† Dickinson, Jour. R. A. S., 1852, 249.

‡‡ Low's Animals. 238.

§§ Bewick's Quadrupeds, 8th edit., 39, note.

dark muzzles.* They are said to have been originally brought from Whalley Abbey, in Lancashire, upon its dissolution in 1542.†

The herd at Burton Constable, also in Yorkshire, situated in the district of Holderness, all perished in the middle of the last century of an epidemic disorder. They were of large size, and had the ears, muzzle and tip of the tail, black.‡

At Chartley Park, in Staffordshire, England, the property of Lord Ferrers, Low states that a herd exists, resembling those at Chillingham, but of larger size, and having the muzzles and ears black. He also adds that they frequently tend to become entirely black. This herd is very ancient, having existed in this park from time immemorial.§

Wild cattle, says Low, have been or are yet preserved at Wolaton in Nottinghamshire and at Limehall in Cheshire, England.|| and Bewick states that the ears and nose of all of them are black.¶

These cattle, in the possession of ancestral families, and maintained and protected in parks, undoubtedly as a family pride, have with difficulty been preserved through the epidemics and casualties of a few centuries. Yet, despite the human care and the rigorous weeding out of blemishes, we can see they were unable to retain in their color or form much more than a resemblance. In the Chillingham cattle the muzzle is described as black or brown, the ears inwardly, and in part externally, red, reddish-brown and red or brown. Their manes either short, or rudimentary, or not existing. We find black ears and blemishes occurring at different times. In the Hamilton herd we find them generally with horns at an early date, but afterwards the females usually polled. Black spots on sides and legs are noticed. They are described as possessing manes of from four to five inches long, especially some bulls. Their limbs have become stouter and their heads shorter than the Chillingham breed at the other end of the ancient wood. Those at Drumlanrig have become polled, presumably in both sexes. At Gisburne Park, they are not only hornless, but only the inside of their ears are colored, and occasionally they lose their dark muzzle. At Burton Constable, among their fertile pastures, we see an increase of size, the effect of the abundance of the feed, and the ends

* An. and Pl. under Dom., i, 108. † Bewick's Quadrupeds, 8th edit., p. 39, note.

‡ Low's Animals, 238. § Low's Animals, 238. || Low's Animals, 238.

¶ Bewick's Quadrupeds, 8th edit., 39, note.

of the tail have become black. In Staffordshire, we observe the tendency to become entirely black.

When even selection finds it so difficult to preserve the uniformity of the same herd for successive years, and fails even more glaringly when applied to different herds under varied circumstances, we can hardly be justified in rejecting these white cattle as the primitive or foundation stock of existing breeds of that county on account of their color alone.

The wild state seems peculiarly favorable to uniformity of coloring, as the causes which have operated to produce the result on a few act likewise upon all, and are constant in their action. Any deviations from the markings appear to become absorbed in the multitude, so as to have little opportunity for preservation. In civilization, on the contrary, we have the element of human will, a highly complex and variable possession, which interrupts the apparent harmony of uncultured nature, by rendering new combinations possible and probable. That a slight interference with a natural state will produce variability of coloring is well shown in an account of the cattle of Paraguay by Azara, wherein it is stated that the wild cattle are always a reddish pard color, and thus differ in color from the domesticated breeds.* When it is considered how little tameness is called domestication in these regions, it is realized upon what obscure causes the fact of color must depend. Even in our most ancient breeds we find variations of color, as in the Highland, Galloway and Devon.† The strongest single argument in favor of these white cattle being the forefathers of our present stock, is in the occasional cases of reversion, which occur in many of the breeds, and oftener in those whose connection with the wild breed seems probable. In the West Highland breed, usually black, the white color and the ear markings in many cases return.‡ In the Ayrshire cow I have record of two cases of reversion to white with red ears, and I can remark, after a most careful examination of Ayrshire cows, that I have never seen white ears, or ears the tips of which were other than red, brown or black. In shape we have the differences inherent to locality. Mountain breeds are apt to be lighter in their hindquarters than breeds occupying a plain, as we are told by Low,§ and it is obvious to any observer that semi-domesticated breeds are lighter in the flanks

* Nat. Hist. of the Quadrupeds of Paraguay, Edinb., 1838, 73.

† Low, *passim*. ‡ Low's Animals, 301. § Low's Animals, 305.

and loins, than those breeds which have been subjected to systematic breeding. In the Ayrshire breed we find the medium horn, often the direction of the curve and the frequent black tip pointing to the wild breed, as also the white face, or starred forehead, and the "rigged" back occasionally or frequently recurring, to direct our attention to the transition cattle between the original stock, and the recorded results of breeding, coeval with the advanced interest in agricultural pursuits at or about 1800.

These cattle in their present state are easily and readily tamed and crosses with common stock are occasionally noted. Such with the forest bull are said by Bewick to invariably take the color of the father and to retain some of the fierceness.* The recorded instance of the crossing of a cow of the white breed by a common bull gives the color of the progeny as after the forest pattern, but with mottled legs.†

When we consider the small number of these cattle, and the length of time they have been preserved, and how narrowly they have escaped utter extinction, it is difficult to suppose that they have been retained in their purity; still less when we consider the disturbances of the times, the number of cattle grazing continually in their vicinity, and the striking resemblance which is often shown to them by cattle of other breeds. According to Low, individuals were to be met with in 1845, in the county of Pembroke, in no ways distinguishable from the wild cattle of the Parks,‡ and Aiton speaks of their resemblance to the common cattle of 1750. I have myself seen in America, cattle which were pure white with red ears, and even polled.

The only explanation which I can see for the variations between the herds of forest cattle and the tendency towards variation, which seems from our account to have been ever strong, is that these, as well as the domestic cattle of those regions, are offshoots from the same original stock, the wild ox of the past, but that those races we call domesticated, as the Ayrshire, the Angus, the Galloway, the Highland and others, have been influenced to a greater extent by the arts of civilization, the conscious or unconscious breeding for certain uses, and the effects of crossing, than these inhabitants of the parks.

On this view the White Forest Breed is a wild animal, a descend-

* Bewick's Quadrupeds, 41, note.

† Hindmarsh, Ann. and Mag. of Nat. Hist., 1839, ii, 280.

‡ Animals, 293.

ant, with now and then a bar sinister, of the wild breed, and the domesticated races of the country are likewise their descendants, but with an ancestry hopelessly confused and intermixed by outside crosses and influences.

EXPLORATION OF THE GULF OF MAINE WITH THE DREDGE.

BY A. S. PACKARD, JR.*

THOUGH it was the original intention to devote the month to an exploration of George's Bank, it was decided on account of the "Bache's" defective boilers to work nearer shore and extend farther from land the work of the U. S. Fish Commission, for the season located in Casco Bay; the dredging operations being conducted under the charge of Professor Verrill. This involved an examination of certain unexplored portions of that great indentation lying between Cape Sable, Nova Scotia, and Cape Cod, and which is laid down on the charts as the "Gulf of Maine."

Through the researches of Messrs. Stimpson, Verrill, myself and others in the Bay of Fundy, and of Drs. Gould, Wheatland, Stimpson and others in Massachusetts Bay, together with the very thorough examination of Casco Bay and vicinity pursued during the past summer by Professors Baird and Verrill, we had attained a very complete knowledge of the coast fauna of New England north of Cape Cod. Moreover, the explorations of George's Bank made by Messrs. Smith, Harger and myself last year in the "Bache," had given us some idea of the nature of the sea bottom there, dredging having been carried on at a depth of four hundred and thirty-two fathoms by Messrs. Smith and Harger, and in one hundred and fifty fathoms by myself.

*Report of Explorations with the Dredge on the U. S. Coast Survey Steamer "Bache," in the Gulf of Maine, during September, 1873, under the direction of Prof. Baird, U. S. Fish Commissioner, made to the Superintendent of the Coast Survey and to the U. S. Commissioner of Fisheries. In all the work I had the invaluable aid of Mr. C. Cooke, with his great experience in dredging, and owe much to the ready aid and sympathy of Commander Howell, Executive Officer W. H. Jaques, and Lieuts. Hagerman, Jacob, Rush, Bradbury, and Dr. Dickson. Samples of bottom water were taken up at nearly every station, the metal water bottle being used. For the identification of the specimens I am indebted to Professor Verrill.

It now remained to explore some interesting localities within George's Bank, and at a distance from the coast. This report embraces an account of a reconnaissance of Jeffrey's Bank, lying south of Mt. Desert Island; Cashe's Ledge, another bank lying southwest of Jeffrey's Bank; of Jeffrey's Ledge, a northeastern submarine prolongation of Cape Ann; and Stellwagen's Bank, a northerly extension of Cape Cod. As intermediate points were investigated, the series of dredgings may be regarded as conducted along six main lines, running out easterly from the shore between Portland and Cape Cod.

On the 2d of September, the "Bache," with Lieut. Jaques temporarily in command, left Peak's Island, Casco Bay, the headquarters of Professor Baird and his associates, and made a harbor for the night at Boothbay. Early the next morning we ran out and dredged about "Monhegan Falls," in sixty fathoms, searching with dredge, tangle and trawl for the arctic coral (*Primnoa lepadifera*), a species of sea fan which grows about three feet in height. It is occasionally met with in the fiords of Norway at a depth of three hundred fathoms, while fishermen have been said to find it on the ground known as "Monhegan Falls," and a specimen two feet high, from George's Bank, is now in the museum of the Peabody Academy of Science. Our efforts to find it were, however, unavailing.*

We then ran out to Jeffrey's Bank and trawled in eighty-two fathoms, bringing up a fine Comatula (*Antedon Sarsii*), a near ally of the crinoids; this was the first specimen taken by the Fish Commission during the summer. The disk of another specimen

* In stations 1, 2, 3, 4 and 5 of my notes, and all from within ten to fifteen miles south of Monhegan Island (station 5 being fifteen miles southeast of Monhegan Island), in from fifty-eight to seventy-two fathoms soft mud, with a bottom temperature of 42° and 43° occurred either at one or another station, though mostly in station 5, seventy-two fathoms, the following:—*Nymphon giganteum*. Crustacea, *Hippolyte spina*, *Ptilocheirus pinguis*, *Byblis Gaimardii*, *Stegocephalus ampulla*, *Anthurus brachiata*. Among worms, *Aphrodite aculeata*, *Eunoe Cuvierii*, *Nephtys ingens*, *N. ciliata*, *Ninoe nigripes* Verr., *Nothria conchylega*, *N. opalina* Verr., *Goniada maculata*, *Trophonias aspera*, *Sternaspis fessor*, *Ammotrypane fimbriata*, *Chaetozone setosa*, *Nicomache lumbricalis*, *Maldane Sarsii*, *Praxilla gracilis*, *Terebellides Stroemi*, *Melinna cristata*, *Amage auricula*, *Amphiteis Gunneri*, *Myzicola Steenstrupi*, *Chaetoderma nitidulum*, *Priapulius* n. sp., *Phascolosoma camentarium* and *Meckelia lurida* Verr. Among the more interesting shells were *Siphonodentaltum vitreum*, *Scaphander punctostriata*, *Aporrhais occidentalis*, *Neera arctica*, *N. pellucida*, *Periploma papyracea*, *Astarte lens*, *Yoldia thraciaformis* and *Y. obesa*. Among Tunicates, *Molgula pannosa*. Among Echinoderms, *Psolus phan-tapus*, *Lophothuria Fabricii*, *Schizaster fragilis* (in seventy-two fathoms only), *Ctenodiscus crispatus*, *Ophioglypha Sarsii*, *O. robusta*, *Ophiocnida hispida*, *Edwardsia fari-nacea*, *Cerianthus borealis*.

was captured on Cashe's Ledge near Jeffrey's Bank. With this also occurred *Nymphon giganteum*, *Calliostoma occidentale*, and *Ophiocnida hispida*. We also dredged in deep brown mud, at a depth of one hundred and seven fathoms, with a temperature of thirty-nine and one-half degrees, several *Hyalonema longissimum* of Sars, hitherto only found on the coast of Norway in from one hundred and twenty to three hundred fathoms. This had previously been found off Casco Bay by Prof. Verrill. Other interesting sponges occurred, and a rare sand-star, *Ophioscolex glacialis*, new to America,* and which was dredged by Thompson at a depth of six hundred and forty fathoms near the Færøe Islands. Everywhere on Jeffrey's Bank and Cashe's Ledge the mud was reddish-brown. At noon of September 4th the sea became too rough to dredge, and we ran into a harbor at George's Island, north of Monhegan, for shelter, and on the succeeding day returned to Portland for repairs. On September 12th the "Bache" left Portland for a farther exploration of Jeffrey's Bank, Capt. Howell in command, and on the 13th a series of dredgings were made on each side of the southern extremity of it, at depths of sixty, † one hundred and five, and one hundred fathoms (the last point being Station 17. Here the arctic sponge, *Hyalonema longissimum*, occurred), with excellent success. The weather appearing threatening we ran into Portsmouth.

On the 16th we began to dredge on a line extending from Portsmouth to Cashe's Ledge. Stopping to dredge on either side of Jeffrey's Ledge, we found in a mud hole ninety-five to ninety-eight fathoms deep, 14 miles S. E. $\frac{1}{4}$ E. of Boone Island Light, with a temperature of $37\frac{1}{2}^{\circ}$ and $41^{\circ}\frac{1}{2}$ living *Schizaster fragilis*, a beautiful deep sea urchin; *Molpadia oölitica*, a sea cucumber; *Macoma sabu-*

* Here also occurred among the worms, *Leanira tetragona*, *Nephtys ingens*, *N. ciliata*, *Ninoë nigripes*, numerous specimens of *Nothria opalina*, *Goniada maculata*, *Scalibregma inflatum*, *Sternaspis fossor*, *Nichomache lumbricalis*, *Maldane Sarsii*, *Praxilla gracilis*, *Terebellites Stroemii*, *Melinna cristata*, *Amphicteis Gunneri* and *Sabella zonalis*. Also the following shells: *Siphonodentalium vitreum*, *Scaphander punctostriata*, *Periploma papyracea*, *Cryptodon obesus*, *C. Gouldii*, *Yoldia thraciaformis*, *Y. obesa*, the rare *Dacrydium vitreum*; and among Echinoderms, *Schizaster fragilis* and *Ctenodiscus crispatus*.

† Station 12, brown mud, with a bottom temperature of 42° ; here occurred *Dentalium occidentale*, *Siphonodentalium vitreum*, *Scaphander punctostriata*, *Periploma papyracea*, *Macoma sabulosa*, *Cryptodon obesus*, *C. Gouldii*, *Astarte lens*, *Cyprina islandica*, *Yoldia obesa*, *Dacrydium vitreum* and *Modiolaria corrugata*.

‡ The readings of both thermometers used are given; the lowest temperature being that given by a new Casella-Miller thermometer from the Smithsonian Institution and probably nearly correct.

losa and *Aporrhais occidentalis* (Fig. 46), two shells rivalling in size individuals dredged by me in shallow water in Labrador. With these also occurred the remarkable *Cerianthus borealis*, Yol-

Fig. 46.

*Aporrhais occidentalis*.

Fig. 47.

*Yoldia thraciaciformis*.

dia thraciaciformis (Fig. 47; this and 46-52, from Gould's Shells of Mass.) and *Hyalonema longissimum*. This deep valley, so near the shore, afforded the lowest temperature ($36\frac{1}{2}^{\circ}$) found during the month's work.

The result of the exploration on Cashe's Ledge was extremely interesting; at depths varying from fifty to eighty fathoms over a hard, gravelly bottom characterized by multitudes of *Ascidia callosa*, or sea potatoes, the richest assemblage of life was found that we met with in the gulf. It was a rare sight to see the tangle come in over the ship's side hung with that gorgeous starfish, the bright red *Hippasteria phrygiana*, measuring fully eight inches across, with lesser forms of *Pteraster militaris*, species of *Archaster* (*A. arcticus* and *A. Parelii*), *Cribella*, *Asterias*, *Antedon Sarsii*, and various sand-stars, a singular barnacle, or Scalpellum (*S. Stroëmi* of Sars), attached to hydroids; an enormous sea spider (*Nymphon giganteum*); *Hyas araneus*, an arctic spider crab, and *Asellodes alta* Stm., with beautiful sponges, such as *Tethya hispida* and

Fig. 48.

*Macoma sabulosa*.

with beautiful sponges, such as *Tethya hispida* and

Thecophora ibla Thompson, dredged by him near the Shetland Islands in from three hundred and forty-four to five hundred and fifty fathoms, and remarkably beautiful spherical forms three or four inches in diameter, these latter appearing in the trawl with *Tealia* and *Cerianthus borealis* of Verrill, a large sea anemone. The excitement was shared in by the crew, some of whom voluntarily aided in the tedious work of separating them from the strands of the tangle.*

On our way back to Gloucester we again dredged on each side of Jeffrey's Ledge at depths of one hundred and twelve and one hundred and eighteen fathoms; at the former station east of the bank dredging the rare hag fish, *Myxine limosa* of Girard (identified by Mr. F. W. Putnam), in soft mud with a bottom temperature in both stations of 39°. On the west side of the Ledge in one hundred and eighteen fathoms occurred *Schizaster fragilis*.

On the 23d dredgings were made in Salem Harbor and off Marblehead. Two days, the 25th and 26th, were devoted to investigating the summit of Jeffrey's Ledge at a distance of nine to ten miles east of Cape Ann.†

* At station 21, beginning with a depth of fifty-two fathoms rocky bottom and drifting off into ninety fathoms gravelly bottom, with sand and some mud, the following species of interest occurred:—*Pycnogonum pelagicum*. Crustacea, *Hyas araneus*, *H. coarctatus*, *Lithodes maia*, *Pandalus annulicornis*, *Caridion Gordoni*, *Hippolyte borealis*, *H. pusiola*, *Thysanopoda* sp., *Tritopsis aculeata*, *Paramphithoe cataphractus*, *P. pulchella*, *Geryus lynceus*, *Unciola irrorata*, *Ascidodes alta* and *Balanus porcatus*. Worms, *Hermione hystrix*, *Harmothoe imbricata*, *Euprosyne borealis*, *Nereis pelagica*, *N. fucata*, *Eunice virida*, *Nothria conchylega*, *Ninoë nigripes*, *Trochonia aspera*, *Tecturella flaccida*, *Nichomache lumbicalis*, *Cistenides granulatus*, *Terebellides Stroeimii*, *Thelopus cincinnatus*, *Amphitrite cirrata*, *Myxicola Steenstrupi*, *Sabella zonalis*, *Potamilla aculifera*, *Protula media*, *Filigrana inflexa*, *Vermilia serrula*, *Spirorbis lucidus*, *S. quadrangularis*, *Phascoloma borealis*?, *P. cementarium*, *Nemertes affinis*, *Admete viridula*. Mollusks, *Astyris rosacea*, *Buccinum undatum*, *Neptunea decemcostata*, *Natica clausa*, *Calliostoma occidentale*, *Diadora noachina*, *Polycera* sp., *Scaphander punctostriata*, *Entalis striolata*, *E. agilis*?, *Mya truncata*, *Macoma sabulosa* (Fig. 48), *Yoldia obesa*, *Modiolaria corrugata*, and other common shells. Among the Tunicates, *Ascidopsis complanatus*, *Cynthia carnea*, *Ascidia* n. sp., *Amarœcium glabrum*, *A. pallidum* and *Leptoclinum albidum*. Polyzoa, *Discoscigeria lucernaria*, *Idmona pruinosa*, *Tubulipora crates*, *Hornerea lichenoides*, *Crisia churrua*, *Flustra solida*, *Discopora Skenei*, *Cellepora ramulosa*, *C. scabra*, *Myrtilum subgracile* and others. Among Echinoderms, *Lophothuria Fabricii*, *Schizaster fragilis*, *Asterias vulgaris*, *Leptasterias tenera*, *L. compta*, *Stephanasterias alba*, *Solaster endeca*, *Cribrella sanguinolenta*, *Hippasteria phrygiana*, *Archaster arcticus*, *A. Parelli*, *Pteraster militaris*, *Ctenodiscus crispatus*, *Ophiocnida hispida*, and other common Ophiurans, *Antedon Sarsii*; and among other sponges *Thecophora ibla*, *Polymastia* sp., *Tethya hispida*, *Isodictya* sp. and *Hyalonema longissimum*.

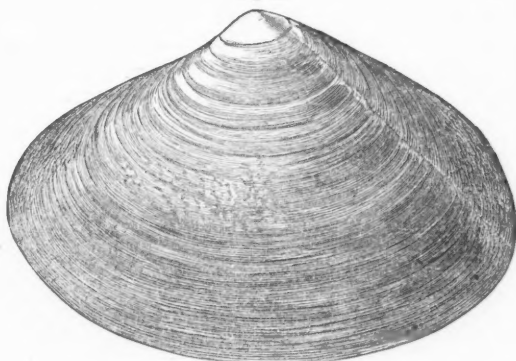
† From stations 27, 28 and 29, from six to fourteen miles east and northeast of Thatcher's Island light, Cape Ann, on top of Jeffrey's Ledge, in from twenty-four to thirty-three fathoms rocky and pebbly bottom, the following more interesting animals

The temperature here was between 46° and 49° in about twenty-five fathoms, a difference of about ten degrees from that of the bottom on each side of this submarine elevation. Both here and afterward we used two dredges, one being thrown over from the bows, the other cast from the stern of the vessel, while the tangle was put over from her side. On the 27th we began to run a line of dredgings and soundings from Cape Ann to Cape Cod, crossing the middle of Stellwagen's Bank. Dredging in depths between fifty and sixty fathoms in soft blue mud northwest of Stellwagen's Bank, in the deepest portions of Massachusetts Bay, the fauna was found to closely resemble similar localities on each side of Jeffrey's Ledge, the assemblage not more southern in character, while the temperature of the bottom water ranged between $41\frac{1}{2}^{\circ}$ and 45° (two thermometers being used as before). In one haul of the tangle ninety-five *Ctenodiscus crispatus*, the common pentagonal starfish of muddy bottoms, were brought up, with several very large *Asterias vulgaris*, and several young *Solaster endeca* and *papposa*. Also a gigantic Corymorpha, a hydroid polype six inches in height and fully half an inch in diameter near the base. It seemed to be a large specimen of *C. pendula*, which we afterwards dredged abundantly on the bank. We found on Stellwagen's Bank, in twenty-two to thirty fathoms coarse sand (temperature $48\frac{1}{2}^{\circ}$ and $50\frac{1}{2}^{\circ}$), an abundance of *Macra ovalis* (Fig. 49) the hen clam, *Cyprina Islandica* (Fig. 50) a shell resembling the quahaug, and *Glycimeris siliqua* (Fig. 51), a valve of *Panopæa Norvegica* (Fig. 52), with fine sponges. The Corymorpha was here

were taken with dredge and tangle; the more common forms are not mentioned:—*Pycnogonum pelagicum*. Crustacea, *Eupagurus Kroyeri*, *E. pubescens*, *Hippolyte borealis*, *H. polaris*, *H. aculeata*, *H. Fabricii*, *Tritopsis aculeata*, *Acanthogone cuspidata* and *Balanus porcatus*. Worms, *Eunoea Erstedii*, *Cryptonota citrina*, *Nereis pelagica*, *N. fucata*, *Trochonia aspera*, *Thelepus cincinnatus* abundant, *Amphitrite cirrata*, *Myxicola Steenstrupi*, *Sabella zonalis*, *Potamilla aculifera*, *Protula media*, *Vermilia serrula*, *Spirorbis lucidus*, *S. quadrangularis*. Mollusks, *Neptunea curta*, *Aporrhaia occidentalis*, *Natica clausa*, *Turritella acicula*, *Margarita Grænlantica*, etc., *Calliostoma occidentalis*, *Hancula mendicaria*, *Eutalis striolata*, *Panopæa Norvegica*, *Mya truncata*, *Cyclocardia Norvegica*, *Astarte lens*, *A. undata*, *A. quadrans*, *Nucula delphinodonta*. Tunicates, *Ascidopsis complanatus*, *Molgula retortiformis*, *Ascidia* n. sp. (the same as in stations 21 and 32, 33, 35). *Amarœcium glabrum*, *A. pallidum*, and *Leptoclinum albidum*. Brachiopoda, *Terebratulina septentrionalis*. Polyzoa, *Discosfascigera lucernaria*, *Idmonea pruinosa*, *Flustra solida*, *Cellepora ramulosa* and *C. scabra*. Radiates, *Leptasterias tenera*, *L. compta*, *Stephanasterias albula*, *Pteraster militaris*, *Ophiocnida hispida*, *Halcidium muricatum*, *Grammaria abietina*, *Campanularia verticillata*, *Cornulariella modesta*, and *Alcyonium carazum*. Sponges, *Thecophora ibla*, *Polymastia* sp. (the same as at stations 21 and 32-35), *Tethya hispida*, *Trichostemma* sp., *Isodictya* sp. (the same as at stations 21 and 32-35).

abundant, though much smaller, and the tangle brought up at a

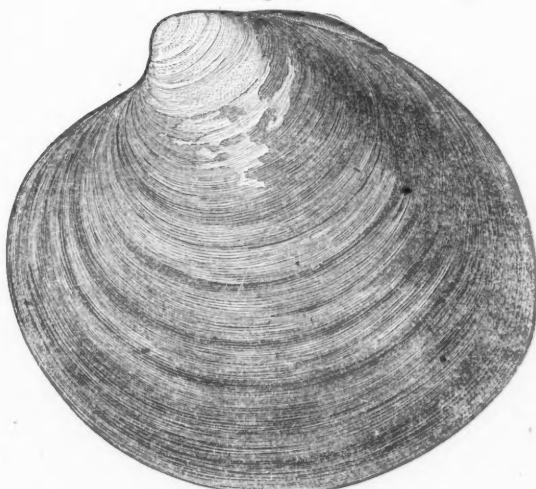
Fig. 49.



Maetra ovalis.

single haul from three hundred to four hundred starfish, mostly *Asterias vulgaris*. At night about ten miles north of Cape Race

Fig. 50.



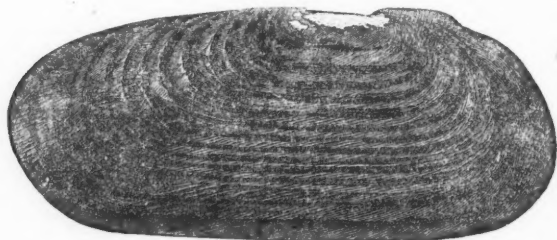
Cyprina Islandica.

the tangle was kept over from half past ten until two o'clock,

when it came up loaded with *Astrophyton Agassizii*, or Medusa's Head, and other kinds of starfish, the temperature being between 48° and 50° at a depth of thirty-four fathoms.*

But by far the most interesting results were obtained at a distance of about fifty-five miles due east of Boston in depths of one

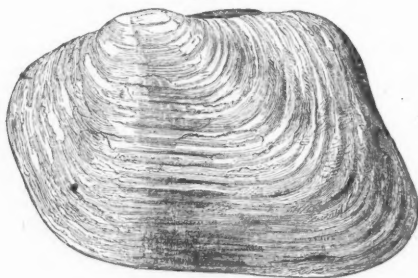
Fig. 51.



Glycimeris siliqua.

hundred and seventeen and one hundred and forty-two fathoms, with a bottom temperature of 39° to $43\frac{1}{2}^{\circ}$; the former (39°) prob-

Fig. 52.



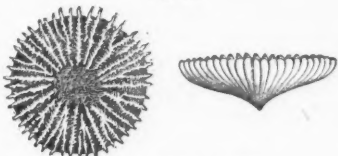
Panopaea Norvegica.

ably the most accurate determination. Here in a remarkably te-

* At Stations 32, 33, 34 and 35 upon or near Stellwagen's Bank, though the fauna is very similar to that of Jeffrey's Ledge, the following species occurred, not met with at stations 27-29:—Crustacea, *Hyas araneus*, *Cancer irroratus*, *Eupagurus Bernhardus*, *Hippolyte borealis*, *H. pusiola*, *Paramphithoe cataphractus*, *P. pulchella*, *Moera Danae*, *Unciola irrorata*, *Phoxus Kroyeri*, *Ptilocheirus pinguis*. Worms, *Nothria opalina*, *Rhynchobolus albus*, *Goniada maculata*, *Nichomache lumbricilis*, *Cistenides granulatus*. Mollusks, *Neptunea decemcostata*, *Acicula borealis*, *Scalaria Groenlandica*, *Bulbus flavus*, *Turritella erosa*, *Lepeta caeca*, *Scaphander punctostriata*, *Glycimeris siliqua*, *Lyonsia hyalina*, *Pandora trilineata*, *Cyclocardia borealis*, *Pecten tenuicostatus*. The hydroid *Tubularia indivisa*, and a sponge, *Polymastix robusta*?

nacious soft blue mud, we found indications of an intermixture of the abyssal fauna characteristic of depths in the north Atlantic between one hundred and one thousand fathoms, with a temperature of about 39° Fahr. At the first station (36) examined, in one hundred and forty-two fathoms (temperature 39° to 42°) a large *Geryon* of a deep reddish flesh color occurred, having more spines on the carapace than in *G. tridens*, and with eggs. Associated with this arctic crab occurred two fragments of a true cup-coral allied to *Caryophyllia*. On submitting the specimens to Count Pourtales, he at once pronounced it a species of *Deltocyathus*, and on comparison

Fig. 53.

*Deltocyathus Agassizii*.

with specimens of *D. Agassizii* Pourt. (Fig. 53, after Pourtales), from depths varying from sixty to three hundred and twenty-seven fathoms between Cuba and Florida, our specimens did not differ specifically. Pourtales remarks (p. 15) that "this coral has been pronounced by Dr. Duncan, identical with the fossil species *D. Italicus*, and though closely allied is yet readily distinguished by the costæ and other characters." With the crab and coral occurred *Amphiura Otteri* of Ljungmann, dredged by the Swedish Josephine expedition in five hundred and fifty fathoms off the coast of Portugal; it agrees perfectly, I am told by Prof. Verrill, with the description of that species. It also occurred in the one hundred and seventeen fathom station near by. Such facts as these, the occurrence of an abyssal form of sand-star on opposite sides of the Atlantic, and of the *Deltocyathus*, seem to favor Lovén's theory of a uniform fauna throughout the bottom of the deeper parts of the Atlantic.* At the same station occurred *Schizaster fragilis* and certain shells, among them *Dacrydium vitreum*, and several worms.† The other station (37) was ten

* I may add that on looking over some gravel dredged in October, 1872, in one hundred and fifty fathoms just northeast of the St. George's Banks, a fragment of another coral occurred, which is entirely new to the coast of North America. It is the *Ulocyathus arcticus* of Sars, as identified by Prof. Verrill.

† The following list comprises all the species found at station 36. Those with * were found at 37 also. Crustacea, **Geryon* sp., *Ilyas araneus*, *Scalpellum* sp. Worms, *Nephtys ingens*, *Lumbriconereis fragilis*, *Nothria opalina* V., **Spiochaetopterus*? (tubes) **Sternaspis fossor*, *Ammonocharax* sp., *Maldane Sarsii*, **Arenia* sp. nov., *Terebellides Stroeemii*, *Thelepus cincinnatus*. Mollusks, *Neptunea pygmaea*, **Aporrhais occidentalis*, *Lunatia Grœnlandica*, *Doris* sp., **Scaphan-*

miles northwest in one hundred and seventeen fathoms with the same soft tenacious mud; the temperature $36\frac{1}{2}^{\circ}$ to $43\frac{1}{2}^{\circ}$. Here occurred a smaller Geryon, perhaps a male; and apparently, judging by Wyville Thompson's figure in his work "The Depths of the Sea," p. 881, very closely related to Kroyer's *Geryon tridens*; with this was associated the western Pelican's foot shell, *Aporrhais occidentalis*, and other shells and worms, and a variety of *Ophioglypha affinis* of Lütken, dredged the previous year by Messrs. Smith and Harger at St. George's Bank. This day ended our explorations, and at night the Bache arrived in Salem.

The results of the month's work besides adding quite a number of forms before unknown to exist on our coast, and a few new to science, show that the fauna of the deeper portions of the Gulf of Maine is *almost* purely arctic, the temperature at about one hundred fathoms being from $36\frac{1}{2}^{\circ}$ to 39° . The only apparent exception to this arctic fauna is the presence of a dead broken specimen of the coral *Deltocyathus*, which however is not improbably a member of the deep sea Atlantic fauna, and may be found living nearer the edge of the Gulf stream in the neighborhood of the St. George's Banks. The fauna of the sandy portions, such as around the southern portion of Stellwagen's Bank, is similar to sandy beaches and adjacent bottoms on the coast of Labrador. As the arctic fauna is best known in northern Norway, so our researches this year have brought to light several forms hitherto only known from Norway, and show that the fauna of that country is identical with that of a region so far south as the area between Cape Sable and Cape Cod, and bounded on the southeast by the Gulf stream. That the waters of the Gulf of Maine do not support a fauna *purely* arctic is shown in the absence of *Rhynconella psittacea*, while *Ophioglypha nodosa* so abundant in shallow bays in Labrador is also wanting. Moreover *Cardium islandicum*, *C. Haysii*, and *Serripes Groenlandica* do not occur in anything like the abundance and size in which they may be found in shallow water (five to ten fathoms) on the coast of Labrador.

der punctostriata, *Dentalium occidentale*, **Negrea arctica*, *N. pellucida*, *Macoma sabulosa*, *Cardium pinnulatum*, *Cryptodon obesus*, *Lucina filosa*, *Astarte lens*, **Leda tenuisulcata*, *Yoldia thraciformis*, *Y. obesa*, *Dacrydium vitreum*. Polyzoa, *Discosfascijera lucernaria*, *Cellepora ramulosa*, *Discopora Skenii*, *Hornerea lichenoides*, *Myriozeugum subgracile*. Radiates, *Gemellaria laricata*, **Schizaster fragilis*, *Thyone* sp., **Amphiuva Otteri*, **Ophioglypha Sarsii*, *O. affinis* (at station 37 only), *Endendrium ramosum* (at 37 only), *Sertularella polyzonata*, *Deltocyathus Agassizii*, **Edwardsia* species.

Finally, the liberality of Professor Pierce, the Superintendent of the Coast Survey, in placing at the service of the Fish Commissioner a fine steamer and every convenience for dredging during an entire month, leads us to indulge the hope that it may in the future seem necessary to the work of the Coast Survey, to make a map of the sea bottom within soundings. The soundings in such case would be better done by the dredge than the lead, as a far better idea of the sea bottom could thus be obtained, than by the slight amount of material usually brought up by the lead, and which is sometimes misleading. A naturalist aboard could sort out the animals and send them to experts for identification. Thus, with slight extra expense, the work already begun by M. Pourtales in mapping out the bottom of the Straits of Florida, could be extended, and our north Atlantic sea bottom would be studied and mapped out, and the results, while advancing science, be of great practical value in navigation and the fisheries.

THE YELLOWSTONE NATIONAL PARK.

BY THEO. B. COMSTOCK, B.S.

II. ITS IMPROVEMENT.

HAVING shown, I trust conclusively, the value of the park from a scientific standpoint, we may now consider in a general manner the best and most advantageous methods of maintaining and utilizing its peculiarities. Before proceeding to the discussion of this subject, it will be well to state the provisions of the act of March, 1872, which relate specially to the control and improvement of the dedicated tract of land. I quote the following passages:

"All persons who shall locate or settle upon, or occupy the same, or any part thereof, *except as hereinafter provided*, shall be considered trespassers and removed therefrom."

"Said public park shall be under the exclusive control of the Secretary of the Interior, whose duty it shall be, as soon as practicable, to make and publish such rules and regulations as he may deem necessary or proper, for the care and management of the

same. Such regulations shall provide for the preservation from injury or spoliation, of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition. The secretary may, in his discretion, grant leases for building purposes for terms not exceeding ten years, of small parcels of ground, at such places in said park as shall require the erection of buildings for the accommodation of visitors; *all of the proceeds of said leases, and all other revenues to be expended under his direction in the management of the same,* and the construction of roads and bridle paths therein. *He shall provide against the wanton destruction of the fish and game . . . and against their capture or destruction for the purposes of merchandise or profit, and generally shall be authorized to take all such measures as shall be necessary or proper to carry out fully the objects and purposes of this act."**

It is impossible to find fault with this bill, so far as it goes, for it is a model of concise expression, while it is certainly explicit enough to show clearly its objects and intentions; nevertheless it is marked by one of those strange inconsistencies which seem inseparable from our present system of *unadvised* legislation upon matters connected with public improvements.† I refer to the authority given to the Secretary of the Interior and the duties thereby imposed upon him, without the power of exercising the one or of fulfilling the other. Ample provision has been made for the protection and preservation of the park and its denizens, *provided that no one attempts to injure or destroy within its borders.* But in this, as in other cases, the necessity which has produced

* So far as I am aware no further legislation has been made since the passage of this bill. I have omitted only those portions which refer to the boundaries of the park, with certain passages not essential to completeness of expression.

† I feel it to be due to myself, in consideration of a certain air of novelty or incompleteness which may attach to this article, to state more definitely my position with respect to the question of the relations of science to the General Government. I take this opportunity of recording my views upon this subject not only that I may be more fully understood in the plans here proposed, but also because I believe that the time has come for combined action on the part of scientists. In brief, then, it is my firm conviction that the present system (if such it can be termed) of *unorganized* and *indiscriminate* appropriation of the public funds for scientific purposes is, to say the least unprofitable and detrimental to the best interests of science. This conclusion, based as it is upon a careful study of the facts in the case, naturally leads to the question whether any method possessing equal or greater advantages could be adopted which would have fewer objections. After mature deliberation, I am confident that this is quite possible, as I shall hope to demonstrate hereafter. I cannot now enter into details, nor is it necessary for my present purpose, but these remarks may serve to explain in a measure what might otherwise appear paradoxical or impracticable.

the law demands its execution.* Thus far I am not aware that much has been lost by delay in this respect, for the simple reason that the mere fact that a law exists is sufficient for a short time to deter many from transgressing it. It has now become apparent, however, that there is no "power behind the throne," and so long as this state of affairs continues the danger of spoliation is liable to increase.

Again, the bill does not provide for the improvement of the reservation in any way except that "all of the proceeds of leases, and all other revenues which may be derived from any source connected with said park," are to be expended in its management and the construction of roads. To say nothing of the fact that the first proceeds of such a fund, which is never likely to assume gigantic proportions, must be devoted to the payment of a superintendent's salary, it is evident that "the construction of roads and bridle paths therein" must precede "the erection of buildings for the accommodation of visitors." These roads must, therefore, be constructed in the early future, if the park is to become in any degree the place of resort for which it is intended.

As I have remarked, the whole of this district is now in a state of nature, and while this is by no means unfavorable to investigation, but, in many respects, quite the reverse, it is not conducive to a high state of physical vigor upon the part of the investigator. Until access to the Yellowstone Park from without and movement from place to place within its borders is rendered comparatively easy by the opening of suitable roads, food and other supplies must be transported by pack-trains a distance of more than one hundred miles. This method is not only tedious and expensive, but it is also attended with considerable risk, and the more delicate instruments which are indispensable for accurate work in some departments cannot be transported in this manner at all.† The first requirement for scientific work is, therefore, a

* President Grant, in his late message, recommends legislation to this end, and it is not improbable that it will receive the attention of Congress during this session. The Secretary of the Interior has done all in his power by the appointment, in 1872, of Hon. N. P. Langford, as superintendent. This gentleman has done far more than could be expected of him, and has regularly presented his reports, notwithstanding the fact that his services have been rendered with great sacrifice of comfort, and, so far as I can learn, wholly without compensation.

† Barometers and thermometers can only be carried with safety, by being packed with the greatest care, and strapped to the back of a rider who will rarely allow his animal to move out of a walk. The instances are rare indeed in which chronometers in

system of roads which will afford communication between the principal points of interest. This accomplished, there can be no doubt of the speedy introduction of better methods of transport from without. The enterprising citizens of Montana and Wyoming, encouraged by General Ord, have already agitated the subject of an extended system of national highways through the Territories, and vigorous measures have been adopted to secure their object. This would add greatly to the facilities in this direction, for as I have shown, any direct route between the Montana settlements and the south or east must pass through this reservation or very near to it. But the project of a railroad through that section is not in its infancy, nor can it long be delayed. It is unnecessary to dwell upon these points, for it is obvious, from what has been said, that the attention of capitalists must soon be turned toward this field. I will therefore proceed to show in what ways I consider that the interests of science can be best furthered.

Too much stress cannot be laid upon the great importance of *prompt, constant, extended and connected observation* of the rare and rapidly waning phenomena, which form the most striking and characteristic features of the district under consideration. Taking these points in the order named, it ought to be understood that in order to obtain thoroughly satisfactory results

Action must be prompt.—The evidence thus far obtained, though meagre and fragmentary, points directly to the conclusion that constant changes are taking place in the movements of the geysers and boiling springs, resulting occasionally in the apparent extinction of an active crater, the sudden eruption of one long dormant, or a radical change in the manner of action of another.

The whole region abounds with traces of geysers, solfataras, and other minor evidences of the persistency of heat after the dying out of the volcanic furnaces, proving that the active vents are representatives of the last stage of such action. Several interesting geysers, to which I shall presently refer, have changed in character more or less since first observed.

The Giant Geyser was observed in action in 1870 by Lieut. G. C. Doane, who reports that the eruption continued during three and a half hours. At the time of Dr. Hayden's visit in the following year, the only eruption recorded, though quite as vigorous

use have been successfully transported upon horseback, even with the utmost care and precaution under very favorable circumstances.

as that mentioned by Doane, lasted only one hour and twenty minutes. This geyser was not observed in action by any of Dr. Hayden's party of 1872, nor by the members of the northwestern Wyoming expedition in 1873.*

If we are to reap the greatest benefit from the study of these phenomena, it cannot be denied that "delay is dangerous."

Observation must be constant.—The closest attention to details will avail little, however early, unless ample provision be made for its continuance without interruption. Temporary exploring parties have done their work so far as these are concerned, in the discovery and mapping of their positions, and in gleaning sufficient evidence to show their importance. Every scrap of this evidence is valuable, to be sure, but the main questions at issue can be decided only by the steady and laborious process of accumulating related and coincident facts. This necessity will be more apparent when we consider our ignorance of the phenomena. I can best illustrate this by a brief reference to the known history of several of the most prominent of the craters of the Upper Geyser Basin of Fire Hole River.

The eruption of the "Giantess" so graphically described by Mr. Langford,† who witnessed two violent eruptions within twenty-two hours in 1870, has since been observed only once, on the evening of August 18, 1872, by a portion of Dr. Hayden's party.‡

Another geyser a few rods distant from the "Giantess," but across the river, on account of the approximate regularity of its action, has received the appropriate name of "Old Faithful." I give on the following page a table of twenty-seven eruptions with particulars.§

* Dr. A. C. Peale, Hayden's "Report" 1872, p. 153, says:—"The water in the Giant Geyser seemed to be considerably agitated, but never reached a greater height than about three feet above the top." This was also its condition at the time of my visit last August. This is but one of many similar instances which might be given in illustration of my remarks.

† "Scribner's Monthly," June, 1871.

‡ Mr. Langford reports the maximum height of the column of water projected from this geyser to have been 250 ft. Dr. Peale (*loc. cit.*, p. 149) places the height, in 1872, at less than 40 ft.

§ The seventeen eruptions observed in 1872 are taken from the Report of Dr. Peale, (*loc. cit.*, p. 148). The remainder are from my own notes. Lieut. S. E. Blunt rendered material assistance in this instance.

TABLE.

No. of eruption.	Date.	Eruption began.	Eruption ceased.	Duration.	Intervals of quiet.
	1872.	<i>h. m. s.</i>	<i>h. m. s.</i>	<i>m. s.</i>	<i>h. m. s.</i>
1.	Aug. 17.	3 22 00 P. M.	3 27 00 P. M.	5 00	.....
2.	Aug. 18.	7 27 30 A. M.	7 32 30 A. M.	5 00	.....
3.	Aug. 18.	8 35 30 A. M.	8 40 30 A. M.	5 00	1 03 00
4.	Aug. 18.	9 40 30 A. M.	9 46 30 A. M.	6 00	1 00 00
5.	Aug. 18.	10 46 26 A. M.	10 51 13 A. M.	4 47	0 59 56
6.	Aug. 18.	11 54 31 A. M.	11 59 10 A. M.	4 39	1 03 18
7.	Aug. 18.	1 05 05 P. M.	1 09 46 A. M.	4 41	1 05 55
8.	Aug. 18.	2 15 25 P. M.	2 20 15 P. M.	4 50	1 05 39
9.	Aug. 18.	3 23 51 P. M.	3 28 22 P. M.	4 31	1 03 36
10.	Aug. 18.	4 33 22 P. M.	4 38 22 P. M.	5 00	1 05 00
11.	Aug. 18.	5 41 00 P. M.	5 46 00 P. M.	5 00	1 02 38
12.	Aug. 18.	6 42 30 P. M.	6 47 15 P. M.*	4 45	0 56 30*
13.	Aug. 18.	7 44 30 P. M.	7 49 20 P. M.*	4 50	0 57 15*
14.	Aug. 18.	8 51 00 P. M.	8 55 20 P. M.*	4 20	1 01 40*
15.	Aug. 19.	10 07 00 A. M.	10 11 45 A. M.	4 45*	.....
16.	Aug. 19.	11 12 30 A. M.	11 17 20 A. M.	4 50*	1 00 45
17.	Aug. 20.	11 54 00 A. M.	11 58 20 A. M.	4 20*	.....
	1873.				
1.	Aug. 25.	11 36 00 A. M.	11 41 30 A. M.	5 30	.....
2.	Aug. 25.	12 39 00 P. M.	12 44 00 P. M.	5 00	0 57 30
3.	Aug. 25.	1 41 15 P. M.	1 45 45 P. M.	4 30	0 57 15
4.	Aug. 25.	2 45 20 P. M.	2 50 00 P. M.	4 40	0 59 35
5.	Aug. 25.	3 53 35 P. M.	3 58 00 P. M.	4 25	1 03 35
6.	Aug. 25.	5 11 10 P. M.	5 15 40 P. M.	4 30	1 13 10
7.	Aug. 25.	6 03 15 P. M.	6 07 45 P. M.	4 30	0 47 25
8.	Aug. 25.	7 12 00 P. M.	.....	.....	1 01 15
9.	Aug. 25.	8 14 00 P. M.	.....	.....	.....
10.	Aug. 25.	9 17 00 P. M.	.....	.....	.....

The following tabular list gives the number of recorded eruptions of ten of the best known geysers of the Upper Basin of Fire

* These data, for some unexplained reason, are omitted from Dr. Peale's table, and I have supplied them by simple calculation from the other figures which he gives.

Hole River. If there be any errors, it will be found that the total number is larger than the truth.*

NAME OF GEYSER.	No. of recorded eruptions.	Maximum height of column of water projected according to different observers.		Character of Geyser.†
		Feet.	Feet.	
Old Faithful.....	30	100	to 150	Regular.
Giantess	3	39	to 250	Irregular?
Beehive	7	100	to 219	Irregular?
Castle	7	25	to 93	Fifful.
Grand	8	173	to 225	Regular?
Turban.....	3	25	to 30	Regular?
Giant.....	3	140	to 200	Constant.
Grotto	4	41	to 45	Irregular?
Saw-mill		15	to 25	Constant.
Riverside	3		40	Regular?
Total of recorded eruptions of nine of the best known geysers.....	68			

These facts not only tend to show plainly the paucity of our knowledge, but they furnish in themselves sufficient evidence of the amount which we may hope to gain by a closer study, based upon a wider knowledge resulting from constant observation.

Extended observation is required.—All of the expeditions which have heretofore visited this section have done so during the summer months; hence we have no records of any phenomena within

* This table is intended to include all known observations of eruptions made between 1839 and the present time. As a number of small parties of tourists, miners and others have from time to time visited this locality, it is probable that other eruptions have been witnessed, of which no records have been made in an accessible form. Several of the geysers in this list have also been seen in action by exploring parties without accurate observation. For obvious reasons, I have taken no account of such cases in my list.

† It is impossible from such a small number of ascertained facts, to classify these geysers *correctly*. In the case of "Old Faithful" enough is known to entitle it to be considered regular (approximately) in its action. The terms employed here to denote the character of the "Castle," "Giant" and "Saw-mill" geysers also express clearly enough their respective conditions, *at present*. As for the others, their status is very doubtful.

these limits for a greater period than three consecutive months. The most interesting localities, consequently, have been in all cases very hastily examined. Dr. Hayden has published topographical maps showing the distribution of the principal geysers and hot springs of the upper and lower Fire Hole Basins, and of Shoshone Lake, to most of which he has given more or less appropriate names, but upon neither of his trips did he remain long enough in any one locality for extended observations. The expedition of last summer* was able to devote but a portion of the time to the area included in the park, and the remaining parties have been not only quite small, but they have been much more restricted for want of time.† All of the facts have been collected during the warmest and driest season of the year when the atmospheric precipitation is least abundant and permanent. We know absolutely nothing of the effects of climate upon the temperature, periodicity, or degree of activity of the subterranean waters, directly or indirectly. The relations, if any, existing between the different craters are almost equally undetermined. Even the sources of the water supply and the nature of the heating and projecting agencies are but vaguely understood. In fact nothing connected with the whole subject is well ascertained and the opportunity for *original* investigation is almost unlimited.

It is also quite possible, not to say probable, that many craters which have not yet been seen in action may hereafter prove to be among the most interesting and important geysers. Dr. Hayden describes, in his report for 1872, eruptions of geysers which were not observed the previous year, while two or three which were seen in action in 1871 were not observed in 1872. At least two new ones, I have reason to believe, were seen by myself during the summer of 1873, in the Upper Fire Hole Basin alone. Nor is this all, for there is little doubt that future exploration will be rewarded by the discovery of still other basins or collections of thermal and spouting springs. Notwithstanding the extensive surveys in our western wilds, there are many complicated problems to solve and numerous discoveries to make ere we shall fully realize the vastness and extent of nature's variety.

All observations should be connected.—Any system of observa-

*Northwestern Wyoming expedition.

†I am aware of no case in which any person capable of careful observation has spent so much as one week in recording a series of facts from one locality.

tion, however comprehensive, will be comparatively futile, unless the work of all engaged shall be so connected as to prevent confusion and secure the strength of united effort. This proposition is obvious enough to need no demonstration. I will, therefore, pass directly to the subject next at hand.

It will be seen, by reference to the bill previously quoted, that it is made the duty of the Secretary of the Interior to "provide against the wanton destruction of the *fish* and *game*, etc.," within the reservation. I have already given a list of the principal mammals and birds of this region,* from which those properly included under this head of *game* will readily be selected. Accepting this term in its widest sense, we may, perhaps, infer that this provision, if rigidly executed, will insure the protection of the greater number of the animals mentioned in this list. This, in a measure, secures the fulfilment of the scheme which I have proposed for the *preservation* of these animals. A moment's thought, however, will show the inadequacy of such means, for, in the first place not all of the forms included in my list are representatives of the park fauna, nor is it certain that mere *protection* would, in all cases, be equivalent to *preservation*.† Besides as I have stated, not a few of the species alluded to are well on the way to extermination, and great care might at times be required to prevent extermination. I have not space to consider these points as I could wish, but a few of the facts will not be out of place.

Among the *foreign* animals which I have suggested for introduction into the National "Zoological Gardens" is the bison, which, being erratic in its habits, would need some attention until egress from the park should become disadvantageous to it by the settlement of the surrounding country.‡

The American moose (*Alce Americanus* Jardine), the mule deer (*Cervus macrotis* Say), the big horn mountain sheep (*Ovis montana* Cuvier), and the mountain antelope (*Aplocerus montanus*), wrongly named the Rocky Mountain goat, are undoubtedly among

* See First Part of this article.

† Besides the animals referred to, it seems to me quite possible to domicile in this region, a few at least of those species of other faunas which are in danger of rapid extermination; at any rate, experiments of this nature could do no harm, and they might often prove very beneficial.

‡ I have called the bison a *foreign* animal, because it is not now found within the limits of the reserved tract, but that it would thrive there if introduced is already proven by the abundant remains which are now bleaching in the valleys both within and adjacent to the park, showing that they have but recently been driven from these haunts.

the most valuable and interesting of the denizens of the Rocky Mountains, and I cannot believe that we have yet reached the limit of the adaptations of the order Ruminantia to the wants of man.*

The interesting case of the suckling of the young by the males of *Lepus Bairdii*, before mentioned, ought not to be overlooked, and there are doubtless many discoveries yet to be made of equal interest. The order Rodentia is well represented in this section.

There are many other points of greater or less importance which have occurred to me in connection with the plans of improvement which I have to suggest, but I must be content with a passing allusion to them. I cannot forbear, however, calling attention to one very prominent result to be attained by the setting aside of this tract, and the consequent preservation of the timber, as provided by law. It needs no argument to show the value of the Upper Yellowstone forests as a means of equalizing the distribution of the precipitated moisture, which is collected by the various streams radiating from this point. For many years to come, the timbered district within and around the park must be the main support of the settlements in that region, for without this influence irrigation during a considerable portion of the year will be impossible. Until artificial forests, so to speak, have been produced along the lower valleys of the streams, upon the plains, these timbered areas must constitute the very backbone of successful agriculture. Such being the case, there are few who will not welcome the introduction of most stringent measures for the protection of the wooded districts. Nor is this all, for there are, doubtless, not a few questions of much importance upon which new light will be thrown by the discoveries resulting from the preservation of new and rare forms of plants in these forests.†

* In the Report of the Dept. of Agriculture, 1867, p. 218, an anonymous writer gives a short article with a good plate of *Aplocerus montanus*, from which I extract the following:—"Mr. Lord deems the *Aplocerus* a valuable animal to acclimatize, and thinks it would thrive among the mountains of Scotland, and prove a remunerating 'wool-bearing animal.' Its coat is very thick, and is composed of two classes of hair, one extremely long and somewhat coarse, beneath which is a short, dense covering, very fine, 'as delicate in fibre and texture as that of the famous goat of Cashmere. The outer coat of hair is very long, covering the body, tail, and legs, like the fleece of the merino, being most abundant on the shoulder, neck, back, and thighs." . . . "It would be worth while to ascertain more definitely the precise habits and capabilities of this American animal, and ascertain its pecuniary value, before searching farther through Asia for goats to acclimatize upon this continent, etc."

† That thousands of acres of valuable timber have been (not uncommonly) destroyed by the neglect to extinguish a camp-fire, is a fact which is patent to all who have trav-

The question now naturally arises, What can be done to carry out the several schemes proposed in this paper? This I shall endeavor to answer as fully and briefly as possible. There is one difficulty in dealing with all questions bearing upon the subject of government aid to science, which is that there exists no settled plan of action upon such matters. Those who are most deeply interested have neither time nor inclination to "lobby" for the passage of a bill, much less have they the means with which to purchase its passage by bribery, or the effrontery to offer it. Science is thus left dependent, in too many instances, upon the purely accidental good results which may follow or not, as the case may be. If the idea of a free national park for the benefit of the people is at all consistent with our republican institutions, nothing can be more plain than the duty of government to provide for its maintenance. But the Yellowstone Park, as we have seen, has manifestly a peculiar value aside from its utility as a mere "pleasuring ground," and thus it offers, without material outlay, unusual returns upon the investment.

For purposes of study, it would be best to divide the park into four nearly equal districts, with a small central district. The latter would comprise very few of the objects of great interest, but would contain the central station, which might best be located at the outlet of Yellowstone Lake. The four main districts would thus vary much in point of interest, but the work of research could readily be equalized by proper care and foresight. A chief commissioner, a person of acknowledged ability, occupying the central station, would then be placed in charge of the whole area, with competent officers under him and responsible to him for the performance of their duties. Each of the large districts should contain a principal station centrally located, and as many local stations as might be required for observation and experiment. In other words, we should have what may be styled a perpetual expedition with head-quarters at the central station, composed of several divisions, working in separate fields, each provided with a competent scientific corps of investigators with their assistants.

I have given here the mere outline of a scheme which appears

elled through an uninhabited country. In the face of repeated warnings, there are many who will never learn to adopt the simple precaution of smothering their fires before abandoning them. It has been recommended, and not unwisely, that such wilful neglect should be made a criminal offence.

to me the most practicable and advantageous, simply because I have not the opportunity in this article to enlarge upon its scope and its adaptability to the end in view, but I believe that such a plan will be found adequate for the maintenance and utilization of the park in such a manner as to produce the most satisfactory scientific results; while, as I have shown, there is need of prompt action in some directions, it is not necessary, however desirable, that the whole of this plan should be inaugurated at once. On the contrary, time and money may be saved by beginning upon a small scale, and gradually widening the scope of observation. Eventually, however, such a scheme must lead to the introduction of observers in every important department of scientific research.

The most unpleasant part of the whole subject is the pecuniary difficulty, but I would gladly repose sufficient confidence in the culture of my countrymen, to believe that an enumeration of the immediate practical results to follow from this investment is unnecessary to convince them of its desirability. For the present, no method of accomplishing this plan seems available, except a grant from the General Government of an amount sufficient for the labors of a single year, but we may be justified in hoping that the judicious application of the first grant would render future appropriations more apparently necessary. It would not be difficult to demonstrate the propriety of a large endowment for the improvement of the park, but it is foreign to the objects of this paper, which have been to show the value of the tract, and, in a general manner, to show how it may be used to advantage, without discussing minutely the means to be employed for this purpose.

If the suggestions here made shall aid, in any degree, in advancing the cause of scientific research, more will have been accomplished than the writer has dared to hope.

THE GIANT CUTTLE-FISHES OF NEWFOUNDLAND AND THE COMMON SQUIDS OF THE NEW ENGLAND COAST.

BY PROFESSOR A. E. VERRILL.

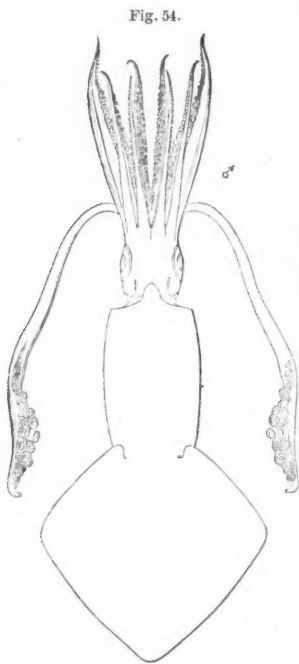
THE various accounts of the appearance and capture of several gigantic cuttle-fishes or "squids" on the coast of Newfoundland, that have recently been published in the newspapers, have excited an unusual interest in animals of this kind. I have been so fortunate as to obtain for examination and description the jaw of the huge specimen found floating at the surface on the Grand Banks in 1871, and referred to by Dr. Packard in his interesting article in a former number of the *NATURALIST* (vol. vii, No. 2, p. 91), and also the jaws and two of the large suckers of a gigantic specimen recently obtained in Bonavista Bay, Newfoundland,* and parts of another smaller specimen, captured in December near St. John. In a future article I propose to describe and figure these remarkable specimens, and will, therefore, at present, merely state that these remains show that two distinct kinds of gigantic squids exist on the coast of Newfoundland. One of these, represented by the jaw obtained in 1871, is a comparatively elongated species, having, according to the measurements made, a body about fifteen feet long and nineteen inches in diameter, with the ordinary arms about ten feet in length and seven inches in diameter (the two long extensile arms of unknown length). This is probably the *Architeuthis monachus* of Steenstrup, as stated by Dr. Packard. The other is represented by the jaws and suckers in my possession and by one of the long extensile arms preserved in the museum at St. John, Newfoundland, which was cut off from the individual that attacked the boat, as described in the February number of the *NATURALIST*, p. 120. Of this, I also have some of the suckers. Possibly a specimen, captured at Coombs Cove, was the same individual that attacked the boat, for, when captured, it had lost one of its long arms, and the one

*For these unique specimens I am indebted to Prof. Baird, of the Smithsonian Institution.

remaining agreed in dimensions with the one preserved. This is a comparatively stout species, having, according to the measurements made, of the last named individual, a body about ten feet long and three or four feet in diameter; the two long, slender, extensile arms were forty-two feet long; the shorter arms about six feet long and nine inches in diameter. One of the jaws of this species resembles the one figured by Dr. Packard (vol. vii,

p. 93, fig. 10) as probably *Architeuthis dux* Steenstrup, and may be the same species.

A smaller specimen was captured in December, in Logic Bay, about three miles from St. John, in herring nets. Photographs were made of this: one showing the entire body, somewhat mutilated anteriorly; the other showing the head with the ten arms attached. The body of this specimen was over seven feet long, and between five and six feet in circumference; the caudal fin was twenty-two inches broad, but short, thick, and emarginate posteriorly on each side, the end of the body being acute; the two long tentacular-arms were twenty-four feet in length, and two and a half inches in circumference, except at the broader part near the end; the tips slender and acute; the largest suckers 1.25 inch in diameter, with serrated edges; the eight short arms were each six



Loligo pallida, one-half nat. size.

feet long; the largest two were ten inches in circumference at base; the others were nine, eight and seven inches. These short arms taper to slender acute tips, and each bears about one hundred large, bell-shaped suckers, with serrated margins. Each of the long arms bears about one hundred and sixty suckers on the broad terminal portion, all of which are denticulated; the largest

ones, which form two regular alternating rows, of twelve each, are about an inch in diameter.

The general form and structure of these giants may be best understood by comparison with the common small kinds found on our shores, to which, in fact, the large ones are closely allied; moreover, their habits are in many respects quite similar.

Of the smaller "squids," at least six species occur on the coast of New England, but some of these are quite rare.

Loligo pallida Verrill (figs. 54, 55). On the southern coast of New England, especially in Long Island Sound and near New York, the species represented by figs. 54 and 55 often occurs in large numbers, and is frequently captured in great quantities in seines, with menhaden or "bony-fish," upon which it probably feeds.

This species I have recently described under the name of *Loligo pallida*.*

The body is stont, tapering rapidly backward. Anterior border of the mantle with a prominent, obtusely rounded, median dorsal lobe, from which the margin recedes on each side; on the lower side the margin is concave in the middle, with a projecting angle on each side. Caudal fin large, about as broad as long, more than half as long as the body. Siphon large and stout; upper pair of arms considerably smaller and shorter than the others, slender at tips, margined along the inner dorsal ridge with a thin membrane. Second pair of arms stouter and longer, triquetral, slightly margined on the outer angle. Third pair much stouter and considerably longer, with a membranous fold along the middle of the outer surface, which expands into a thin membrane toward the end. Tentacular arms long and slender, in extension longer than the body, the portion that bears suckers forming about one-third the whole length; in the female the larger suckers on the middle of this portion are not so large as the largest on the other arms, and are arranged in about four rows; those near the tips of the arms are very small and crowded.

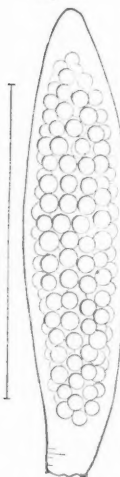
Fig. 55.

Quill of *Loligo pallida*.

* Report of the U. S. Commissioner of Fish and Fisheries, for 1871 and 1872, p. 635, plate 20, figs. 101, 101a. The description and figures are here reproduced with the consent of Professor Baird.

In the male the principal suckers of the tentacular arms are very much larger than in the female, and considerably exceed those of the other arms; they form two alternating rows along the middle of the arm, and external to them there is a row of smaller suckers on each side, alternating with them; the suckers toward the tips are very numerous, small and crowded; outside of the suckers, on each side, there is a marginal membrane with a scalloped edge; another membranous fold runs along the outer surface and expands into a broad membrane near the end; the arms of the ventral pair are intermediate in length between those of the second and third pairs. Ground-color of the body, head, arms and fins, pale, translucent, yellowish white; entire ventral surface pale, with small, distant, brownish circular spots, which

Fig. 56.

Egg Capsule of *L. Pealii*.

are nearly obsolete on the siphon and arms; the upper surface is covered with pale brown, unequal, circular spots, which are not crowded, having spaces of whitish between them; the spots are more sparse on the head and arms, but somewhat clustered above the eyes. The general appearance of the animal when fresh is unusually pale and gelatinous. The "pen" is broad, quill-shaped, translucent and amber-colored. A medium-sized male specimen, preserved in alcohol, measures 145^{mm} from the base of the dorsal arms of the posterior end of the body; length of body, 120^{mm}; length of caudal fin, 70^{mm}; breadth of fin, 75^{mm}; length of first pair of arms, 42^{mm}; of second pair, 50^{mm}; of third, 60^{mm}; of tentacular arms, 150^{mm}; of ventral pair, 53^{mm}.

Loligo Pealii Lesueur * (figs. 56, 57). This is similar to the preceding species in structure, but is more elongated in form and much more highly colored. The color when living is very changeable, owing to the alternate contractions of the spots or color-vesicles, but these spots are much crowded, especially on the back, and the red and brown shades predominate, so as to give a general reddish or purplish-brown color.

* This species is well represented by plate 25, fig. 340, in the last edition of Gould's *Invertebrates*. This figure was erroneously referred to *Ommastrephes Bartramii* by Mr. Binney.

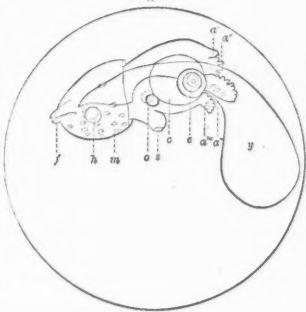
This species when full-grown is over a foot in length, though most of those taken are smaller. It is very abundant in Vineyard Sound and Long Island Sound, and is taken in great quantities in the seines and fish-pounds.

The eggs of this and the allied species are contained in many elongated gelatinous capsules (see fig. 56), which are attached by one end to some common support, from which they radiate in all directions. These clusters are often six or eight inches in diameter, containing hundreds of the capsules each of which is from two to four inches long, and filled with numerous eggs. These are deposited in June and July. By the 20th of June many of these eggs contain embryos in different stages of development (see fig. 57).

Even at this early period some of the pigment vesicles are already developed in the mantle and arms, and during life, if examined under the microscope, these orange and purple vesicles may be seen to contract and expand rapidly and change colors, as in the adult, only the phenomena may be more clearly seen, owing to the greater transparency of the skin in the embryos. They are, therefore, beautiful objects to observe under the microscope. At this stage of development the eyes were brown. In these embryos the yolk is finally absorbed through the mouth, which corresponds, therefore, in this respect, to an "umbilicus." The more advanced of these embryos were capable of swimming about, when removed from the eggs, by means of the jets of water from the siphon.

During July and August the young, from a quarter of an inch to an inch in length, swim free at the surface, and may often be taken in immense quantities with towing nets. They were particularly abundant last summer, in Vineyard Sound, where large numbers

Fig. 57.

Embryo of *L. Pealii*.*

* *a'*, *a''*, *a'''*, *a''''*, the right "arms" belonging to four pairs; *e*, the side of the head; *e*, the eye; *f*, the caudal fin; *h*, the heart; *n*, the mantle in which color-vesicles are already developed and capable of changing their colors; *o*, the internal cavity of the ears; *s*, the siphon; *y*, the portion of the yolk not yet absorbed.

were captured by Mr. Vinal N. Edwards, for the U. S. Fish Commission. These young squids are devoured in inconceivable numbers by fishes of many kinds, and also by the larger jelly-fishes, and many other marine animals.

The larger sizes, and even the adults, are also greedily devoured by blue-fish, black-bass, striped-bass, weak-fish, mackerel, cod, and many other kinds of fishes. Therefore these "squids" are really of great importance as food for our most valuable market fishes.

Ommastrephes illecebrosa. This is the most common squid north of Cape Cod, and extends as far south as Long Island, and Newport, Mass. It is very abundant in Massachusetts Bay, the Bay of Fundy, and northward. It differs from the species of *Loligo* in having distinct eyelids, and also in the more elongated form of its body and the shorter caudal fin. Its internal shell or "bone" is slender in the middle and expanded at each end, instead of being quill-shaped, as in the two preceding species. Messrs. S. I. Smith and Oscar Harger observed it at Provincetown, Massachusetts, among the wharves, in large numbers, July 28, 1872, engaged in capturing and devouring the young mackerel, which were swimming about in "schools" and at that time were about four or five inches long. In attacking the mackerel they would suddenly dart backward among the fish with the velocity of an arrow, and as suddenly turn obliquely to the right or left and seize a fish, which was almost instantly killed by a bite in the back of the neck with their sharp beaks. The bite was always made in the same place, cutting out a triangular piece of flesh, and was deep enough to penetrate to the spinal cord. The attacks were not always successful, and were sometimes repeated a dozen times before one of these active and wary fishes could be caught. Sometimes, after making several unsuccessful attempts, one of the squids would suddenly drop to the bottom, and, resting upon the sand, would change its color to that of the sand so perfectly as to be almost invisible. In this way it would wait until the fishes came back, and when they were swimming close to or over the ambuscade, the squid, by a sudden dart, would be pretty sure to secure a fish. Ordinarily, when swimming,

* This species is not well figured in the last edition of Gould's Invertebrates. Plate 25, fig. 339, which Mr. Binney refers to it, really represents a *Loligo*. Plate 26, figs 341-344 (erroneously referred to *Loligopsis pavo*), was probably made from a specimen of this species, but if so the long arms were incorrectly drawn.

they were thickly spotted with red and brown, but when darting among the mackerel they appeared translucent and pale. The mackerel, however, seemed to have learned that the shallow water was the safest for them, and would hug the shore as closely as possible, so that in pursuing them many of the squids became stranded and perished by hundreds, for when they once touch the shore they begin to pump water from their siphons with great energy, and this usually forces them farther and farther up the beach. At such times they often discharge their ink in large quantities. The attacks on the young mackerel were observed mostly at or near high water, for at other times the mackerel were seldom seen, though the squids were seen swimming about at all hours; and these attacks were observed both in the day and evening. But it is probable, from various observations, that this and the other species of squids are partially nocturnal in their habits, or at least are more active in the night than in the day. Those that are caught in the pounds and weirs mostly enter in the night, evidently while swimming along the shores in "schools." They are often found in the morning stranded on the beaches in immense numbers, especially when there is a full moon, and it is thought by many of the fishermen that this is because, like many other nocturnal animals, they have the habit of turning toward and gazing at a bright light, and since they swim backwards they get ashore on the beaches opposite the position of the moon. This habit is also sometimes taken advantage of by the fishermen, who capture them for bait for cod-fish; they go out in dark nights with torches in their boats and by advancing slowly toward a beach drive them ashore. They are also sometimes taken on lines, adhering to the bait used for fishes. Their habit of discharging an inky fluid through the siphon, when irritated or alarmed, is well known. This squid, like the preceding, is eagerly pursued by many voracious fishes, even when adult. Among its enemies are the full grown mackerel, who thus retaliate for the massacre of their own young by the squids.

The specimens observed catching young mackerel were mostly eight or ten inches long, and some of them were still larger.

A fresh specimen, caught in Casco Bay, had the following proportions: Length of head and body, not including the arms, 221^{mm}; length of caudal fin, 86^{mm}; breadth of fin, 90^{mm}; diameter of body, 35^{mm}; length of upper arms, 80^{mm}; of second pair,

100^{mm}; of third pair, 100^{mm}; of extensile arms, 182^{mm}; of the ventral pair, 90^{mm}.

The length of time required for these squids to become full grown is unknown, as well as the duration of their lives, but as several distinct sizes were taken in the pounds, and those of each school were of about the same size, it is probable that they are several years in attaining their full size. A specimen, recently caught, at Eastport, Maine, was pale bluish-white, with green, blue and yellow iridescence on the sides and lower surface; the whole body was more or less thickly covered with small, unequal, circular, orange-brown and dark brown spots, having crenulate margins; these spots are continually changing in size, from mere points, when they are nearly black, to spots 0.04 to 0.06 of an inch in diameter, when they are pale orange-brown, becoming lighter colored as they expand. On the lower sides the spots are more scattered, but the intervals are generally less than the diameter of the spots. On the upper side the spots are much crowded and lie in different planes, with the edges often overlapping, and thus increasing the variety of the tints. Along the middle of the back the ground-color is pale flesh-color, with a median dorsal band, along which the spots are tinged with green, in fine specks. Above each eye there is a broad lunate spot of light purplish red, with smaller brown spots. The upper surface of the head is deeply colored by the brown spots, which are here larger, darker, and more crowded than elsewhere, and situated in several strata. The arms and fins are colored like the body, except that the spots appear to be smaller. The suckers are pure white. The eyes are dark blue-black, surrounded by an iridescent border.

The remaining species are comparatively rare, and are seldom seen on our shores, their proper homes being probably farther north, or in mid-ocean.

Of the eight-armed group of Cephalopods, only one species, the *Octopus Bairdii* V., has hitherto been found on the New England coast (see AMER. NATURALIST, vol. vii, p. 394, July, 1873). It is not improbable that several other species of squids and Octopi remain to be discovered on our coast. Even the gigantic species taken at Newfoundland may also frequent the northern coasts of New England, or the deep water, off shore, for we really know very little of the active free-swimming animals that inhabit the great depths and cannot be taken with the dredge.

BOTANICAL OBSERVATIONS IN WESTERN WYOMING.

BY DR. C. C. PARRY.

—••—
No. 3.

THE very full botanical list contained in Hayden's Reports for 1871-72 includes most of the plants met with in the Upper Yellowstone basin, being comprised within the limits of the Yellowstone National Park. But as no attempt is made in the above reports to present the subject in its physiographical aspects, and the list as a whole embraces plants derived from other distinct botanical districts, I propose to continue the itinerary sketch of the botanical features presented on our route, noting the characteristic, peculiar, or undescribed plants as they are cursorily brought to view.

The elevated, irregular and bare mountain ridges that bound the Upper Yellowstone basin on the east command by far the finest prospect of this remarkable district. In approaching from any other direction, the distant view is mainly shut off by the dense pine forests that almost continuously cover the adjoining country; but from the Stinking Water divide, reaching above the timber line, the unobstructed view takes in the whole scope of adjoining woodland, the broad expanse of the lake with its deeply indented shores and rocky islets, and on a clear morning wreaths of misty fog, which, rising here and there out of the forest depths, reveal the locality of steam jets or boiling springs.

On leaving these attractive heights to plunge into the sombre forests, we soon lose the peculiar subalpine flora, which gives place to more common woodland forms.

Aquilegia flavescens of Watson is especially abundant with its loose straggling habit and light yellow blossoms, less showy than most species of this attractive genus.

Ledum glandulosum Nutt. is here noticed for the first time on our route, forming bushy clumps with laurel-shaped leaves, and scant clustered heads of white flowers.

Erythronium grandiflorum Pursh here presents in form and habit an exact western counterpart, on a larger scale, of our well known eastern species. Mosses and wood lichens in greater pre-

fusion and variety indicate a moister climate; and along the borders of innumerable springs and ice-cold brooks grow the ordinary forms before noticed, including species of *Cardamine*, *Saxifraga*, *Mitella*, *Mimulus*, *Mertensia*, *Habenaria*, etc., etc.

The absence of any well-marked trails, and the annoying obstruction of fallen timber, obliging frequent détours, are apt to confuse the sense of direction even in those most experienced in wood-craft, and frequent reference to the compass is necessary to maintain a direct course. It is therefore a great relief, both to man and animals, to emerge occasionally into open grassy valleys, which offer something else to engage the eye and thought more pleasantly than dodging the scraggy branches of overhanging pine trees, or devising the best way of escape from a perfect maze of fallen trees. To the botanist especially these little open parks afford the most satisfactory field for observation and collection, however seriously interfered with by the persistent annoyances of insect pests. The Gramineæ here brought to view comprise the ordinary northern forms, including *Phleum alpinum* L., *Vilfa asperifolia* Nees and Meyen, *Agrostis scabra* Willd., *Muhlenbergia Mexicana* Trin., *Calamagrostis Canadensis* Beauv., *Calamagrostis Lapponica* Trin., *Koeleria cristata* Pers., *Melica bulbosa* Geyer., *Poa Andina* Nutt., *Festuca ovina* L., *Bromus breviaristatus* Thurb., *Triticum ægiopoides* Turcz., etc., etc. The Cyperacæ are represented by *Eriophorum polystachyon* L., *Carex rigida* Good., *C. Jamesii* Torr., *C. Douglasii* Boott, *C. aquatilis* Wahl., *C. Reynoldsii* Dewey, *C. leporina* L. and *C. tenuirostris* Olney, ined.

On reaching the shore of Yellowstone Lake the great variety of exposure bordering this magnificent body of water, at an elevation of seven thousand four hundred feet above the sea level, added material attractions to the native flora. High bluff banks here alternate with stretches of sandy or gravelly beach, while numerous inland lagoons, frequently heated by boiling springs, maintain a local temperature often too high for the ordinary phænogamous plants. When, however, this source of internal heat is properly tempered, there is induced a profuse hot-bed growth. But the specific forms are not materially different from those elsewhere exhibited. Strikingly conspicuous among less showy plants were the profuse blossoms of *Gentiana detonsa* Fries. presenting flowers of unusual size, and streaked with the most delicate shades of azure blue. A peculiar form of *Pentstemon secundiflorus* Benth.

was equally distinguished by its brilliant colors and cultivated style of growth. Of other plants affecting such locations we may mention *Spraguea umbellata* Torr., *Chænactis Douglasii* Hook., *Eunanus Fremontii* DC., and, more singular in its associations with neglected fields and gardens, *Brunella vulgaris* L. and *Scrophularia nodosa* L.

Another peculiar plant of this district is that characterized by Dr. Torrey in Hayden's Report as a new genus of Lobeliaceæ, viz: *Porterella carnulosa* Torr. By some inadvertence the synonym of the original plant, described in Botany of Beechey's Voyage, page 362, under the name *Lobelia carnosula* H. and A., was quoted as *Lobelia carnulosa* H. and A., and the changed name adopted for the typical species of this proposed genus. It is still doubtful whether the distinguishing characters are sufficient to entitle this plant to generic rank as distinct from *Lobelia*. The localities in which it was invariably found were recently exsiccated pond-holes in open grassy valleys, which it adorned profusely with its delicate blue flowers; it was here quite constantly associated with *Nasturtium curvisiliqua* Nutt.

While searching in similar localities near the falls of the Yellowstone for fruiting specimens of the latter plant, my attention was directed to a dense subaquatic growth, occupying the basin of a shallow muddy pond. This proved to be *Isoetes*, which Dr. Engelmann, who has assiduously studied this difficult genus, has characterized under the name of *Isoetes Bolanderi* var. *Parryi*. (See Appendix, No. 307.) The numerous additions to this genus, lately made under the inspiring influence of Dr. Engelmann's researches, show how largely dependent is the introductory work of the botanical collector on the supplementary labors of the herbarium botanist.

On the elevated grassy slopes, which at different points afford an agreeable relief to the uniform forest growth, we invariably encounter a well marked subalpine flora in the prevalence of such attractive forms as the following, namely: *Caltha leptosepala* DC., *Oxytropis nana* Nutt.? *Astragalus Kentrophyta* Gray, *Bupleurium ranunculoides* L., *Aster pulchellus* DC. Eaton, *Erigeron ursinum* DC. Eaton, *Aplopappus suffruticosus* Gray, and *Senecio amplexans* Gray. At lower elevations the same open character of country, agreeably set off with copses of *Abies grandis* Lindl., afford a still larger number of interesting forms, including *Ribes*

viscosissimum Pursh, *Peucedanum leiocarpum* Hook., *Ligusticum scopulorum* Gray, *Lonicera caerulea* L., *Aster conspicuus* Lindl., *A. integrifolius* Nutt., *A. elegans* Torr. Gray, *A. Engelmanni* Gray, *Senecio triangularis* Hook., *S. Andinus* Nutt., *Hieracium Scouleri* Hook., *Gaultheria myrsinites* Hook., *Orthocarpus Parryi* n. sp. Gray (see Appendix, No. 218), *Echinosperrum deflexum* Lehm., *Spiranthes Romanzoffiana* Cham., *Fritillaria pudica* Spreng., *Calochortus eurycarpus* S. Watson, *Botrychium simplex* Hitchcock.

At the head of Yellowstone Lake, fringing the muddy shores of one of its numerous inlets, was found in great abundance the well known European plant, *Subularia aquatica* L. This has been regarded as one of the rarities on the American continent, and has been termed by Dr. Gray one of "the late lingerers" which has just managed to maintain its foothold in a few isolated New England lakes: but it seemed to be quite at home on the banks of the Yellowstone. While it is by no means unlikely, as suggested by Dr. Gray, that from its diminutive size and mode of growth, it may have been overlooked in intermediate localities, its occurrence here, in such profusion, so remote from any recognized connection with an ancestral source, is very suggestive in its bearing on the question of geographical distribution, and derivative origin of species. Certainly the localities on this continent where it might have persisted, if originally spread round the northern hemisphere, are sufficiently numerous not to leave such wide gaps as that between Maine and Wyoming! Doubtless, as in other apparently unaccountable cases, future discovery either east or west will help to fill up this chasm.

In the numberless ponds and lagoons which occur near the head of Yellowstone Lake only the usual forms of northern aquatic plants were noticed, including *Ranunculus aquatilis* L., *Nuphar advena* Ait., *Utricularia vulgaris* L., *Lemna trisulca* L., *Typha latifolia* L., *Sparganium simplex* Huds., *Zannichella palustris* L., *Potamogeton perfoliatus* L.

In none of these promising localities was I able to detect the *Nuphar polysepalum* Engel., which seems singularly to affect isolated localities.

The various confervoid growths and obscure vegetable organisms in connection with the numberless hot springs of this region will no doubt reward the special researches of the microscopical

botanist with new and peculiar forms. Before taking final leave of the Yellowstone Park district, it may be proper to allude briefly to the character of the forest growth, so obtrusively forced on the attention of the traveller. Not less than ninety-nine per cent. of the pine growth of this district is made up of the single species, *Pinus contorta* Dougl. Mile after mile of continuous forest may be traversed without seeing any other arborescent species, and their tall, straight, uniform trunks and scattering foliage will be always associated with the monotonous and disagreeable features of the park scenery. Only where the blazing camp-fire sends forth its grateful warmth to relieve the ordinary chill of a night temperature, where the thermometer in August ranges between 36°F. and 14°F., do we realize a manifest utility in this wide-spread forest production. Occasionally, in low moist ground, the balsam (*Abies grandis*) comes in to vary the sombre scenery, and add a deeper gloom to these shaded recesses. On higher mountain ridges, *Abies Engelmanni* Parry makes its appearance, always indicating an elevation of between eight thousand and nine thousand feet above the sea. With this latter is associated, as in the higher mountains farther south, *Pinus flexilis* Torr., but at no point was seen in this district the more exclusively alpine form, *Pinus Balfouriana* Murray.

Abies Menziesii Lindl., which is credited to the park district in Prof. Porter's list, was not seen by me, and as my attention was particularly directed to this subject of forest distribution, it could hardly have been overlooked. It is possible that some of the peculiar forms of *Abies Engelmannii*, in which the cones with their lengthened scales approach *Abies Menziesii* (though still plainly distinct), may have been mistaken in herbarium specimens for this latter species, which was not met with on our route after leaving Wind River valley.

Our route from the southern head of Yellowstone Lake passed by an almost insensible grade to one of the numerous eastern branches of Snake River; thence, skirting along the irregular mountain range to our left, we passed in full view of the Grand Tétos on our right, from which, making a sharp détour to the east, we reached a low divide at the head of Wind River. On this part of our route, being late in the season and on a hurried march, but little opportunity was afforded for botanizing. The general aspect of the flora, as judged from the autumnal forms, was

not materially different from other districts passed over in our previous route. Of plants not elsewhere noticed may be mentioned *Sphæralcea acerifolia* Nutt. and *Rudbeckia occidentalis* Nutt. Near the summit of the high rocky peak overlooking Snake and Wind River valleys was found a new species of *Draba* characterized by Dr. Gray, under the name of *Draba ventosa* n. sp. (see Appendix, No. 15): also *Aster montanus* Rich, the latter only known from high northern collections in British America.

From this accessible pass, by which the Yellowstone Park can be reached on a very direct route, we passed rapidly down the open valley of Wind River and reached our previous rendezvous at Camp Brown, on September 12th, after just two months' absence.

NOTE.—An appendix, containing characters of new species, etc., will follow and conclude this series of articles.

REVIEWS AND BOOK NOTICES.

THE ZOOLOGICAL RECORD FOR 1871.*—To those who live away from libraries and would keep themselves informed as to the annual progress in any department of descriptive zoology, this record is invaluable. Working naturalists, also, more favorably situated, cannot do without it. We have found but few omissions in it, and American articles and memoirs are faithfully reported. The volume has been slow in making its appearance, and we hope better fortune and better health will fall to the lot of the editor and his assistants in the preparation of the volume for 1872.

BOTANY.

THE FERTILIZATION OF GENTIANA BY HUMBLE BEES.—The closed gentian (*Gentiana Andrewsii*) has flowers an inch and a quarter or more in length. These inflated, bright blue flowers of late autumn appear to be always in the bud, as they never open. The corolla is twisted up so as to leave no opening at the top. The flowers are all nearly erect with two stigmas considerably above the five anthers. I see but one way in which it can be fertilized, that is by insects. Several of my students, as well as myself

* Being vol. viii, of the Record of Zoological Literature, edited by Alfred Newton¹ London, 1873. Van Voorst. 8vo. pp. 496.

more than two years ago, have often seen humble bees entering these flowers. They pry or untwist the opening with their mouth organs and legs, and then pop into the barrel-shaped cavity, which they just fill.

THE DESMIDS.—O. Nordstedt has published in the part bearing date 11th Sept. of the "Lunds Universitets Arsskrift" an extensive memoir on the *Desmideae* of S. Norway; over 260 species are described, of which some 20 or more are new. In the same journal Nordstedt describes and figures a new species of *Spirogyra* from Scania (*S. velata*).—*Journal of Botany*.

ZOOLOGY.

ENTOMOLOGY IN MISSOURI.—On pages 471-7, vol. vii, there is a flattering notice of the fifth Missouri Entomological Report, which notice, though lacking the familiar initials A. S. P., is, I infer, from the pen of one of the editors and a co-worker in the cause of economic entomology, who frequently writes over those letters. The notice contains some strictures which call for a reply:

(1) As morphology indicates by the presence of four pairs of jointed appendages in the head, and embryology demonstrates by their early presence, four rings in the head, our author's definition of an insect as 13-jointed does not express the whole truth. (2) He should say 17-jointed, or 14-jointed, counting the head as one, in a popular report of this sort. (3) Four rings can be demonstrated in the head of an insect as easily as that the petals of a flower are modified leaves.

(1) It hardly becomes one who, if my assumption is correct, has in his own writings put forth different opinions as to how many "typical" joints the head of an insect is composed of, to say with such assurance, that embryology "demonstrates" that it is composed of four. The comparatively few species that have been studied embryologically will scarcely warrant our receiving such a statement as an established fact, in face of the many objections that can be brought against it. Most morphologists, believing with Sir Jno. Lubbock that there exists between Crustacea and Insecta a physiological relation analogous to that existing between water and land vertebrata, have been inclined, with Straus-Durekheim, to consider the insect head as 7-jointed, and the insect body as 20-jointed. This is a very desirable number to

give force to the idea of community of descent between these two classes, and community of structure in their exo-skeletons. But neither those who advocate 7 joints to the head, nor those who advocate 4, or 3, or 2, can claim that their particular views are demonstrated; and until they are demonstrated the advocates of the 1-jointed nature of the head have the advantage and will naturally relegate the other propositions to the limbo of pure theory. It is, moreover, difficult to conceive how those who include Arachnids and Myriopods under the term Insect can believe in any present community of structure between them.

My own view of this matter is not badly set forth in an excellent memoir by Dr. H. Schaum "On the Composition of the Head, and on the Number of Abdominal Segments in Insects,"* and to defend it properly would require a whole number of the NATURALIST, and involve a discussion of the value of the speculations so freely indulged in on this head. For this I have neither time nor inclination, and a few words must suffice. I can see no good reason why the jointed appendages of the head should be made to represent separate head segments, any more than the non-jointed appendages; and if any good reason could be given, it ought to apply to the jointed legs of the thorax as well. Yet the apodous insect larva DEVELOPS jointed legs as well as the legged larva. To me the idea that the head is composed of four joints is not a whit more tenable than the opinion that the thorax is composed of six. As Schaum has well said, it is a general law that an insect leaves the egg with the full complement of joints and none are ever added during metamorphosis. Yet many larvæ have a head without the slightest trace of a division into subjoints, and such are frequently blind or even destitute of antennæ, though their imagines possess both eyes and antennæ. Now, how can these organs be said to represent, or be developed from, joints which never had an existence?

(2) I have the satisfaction of being in most excellent company from the days of Lyonet to those of some of our best modern authors, in considering an insect 13-jointed; and to be told that I *should* "say 17-jointed or 14-jointed" does not carry that conviction which the authoritative tone might be supposed to possess. My own experience fully corroborates the views of those authors who consider that in no instance does the number of joints, in

* Ann. and Mag. Nat. Hist; London, vol. xi, 3d ser., 1863, pp. 173-182.

true insects, exceed thirteen, though it may fall short of this number, as in the larvæ of *Hydrophilidæ* which have but twelve. This fact is plainly seen in all insects undergoing complete metamorphoses, where the head constitutes one, the thorax three and the abdomen nine joints. In some insects undergoing incomplete metamorphoses, and notably in *Libellulidæ*, an apparent tenth abdominal joint is visible; but Dr. Schaum, in the article alluded to, has very conclusively shown that what is generally mistaken for the first abdominal joint is but a posterior portion of the metathorax, and I know from conversation with, and from notes and correspondence of my late friend Walsh, who gave this question much study, that he was of the same opinion. A more or less distinct terminal subjoint is also often noticeable at the extremity of the body in many larvæ, and I especially called attention to this fact, when making the statement criticised, and cited as a prominent example, the larva of *Passalus cornutus*.*

In reality, as Erichson and Stein have proved,† this is nothing but the externally protruded anus, analogous to the anal proleg of the larvæ of many Coleoptera. The fact that dipterists have characterized the Cecidomyioidous larva as differing from all other insect larvæ in having fourteen joints shows how universally the insect body is considered 13-jointed; and I have already stated my belief,‡ after examination of many species, that these larvæ form no exception to the rule of having thirteen joints and a subjoint. Strictly speaking, therefore, the body of an insect is composed of thirteen joints and a subjoint; and if we wish to employ a more arbitrary definition, the number 13 will more truly and generally apply than either 12 or 14.

(3) I have shown above that I do not believe this to be a truth; and even if it were irrefutably demonstrated that the head of an insect is composed of four elementary or embryonic joints, I should still speak of it as a single joint in referring to an insect out of the egg; for nothing would be gained, especially in a popular work, in which the abstruse in thought or expression should always be avoided, by substituting the ideal for the real. Though the petals of a flower be modified leaves, we still distinguish them as petals; and he who would attempt to do away with all the dis-

*5th Rep., p. 7, note.

† Vergleichende Anatomie der Insecten, quoted by Schaum.

‡ 5th Mo. Rep., p. 114, note.

tinctive terms, as wing, fin, arm, etc., used to designate the known modifications of the same embryonic organ, would not, to my mind, cause more confusion, or be less justified, than is he who calls an insect's body 17-jointed simply because what is so palpably a single joint, was originally formed out of four embryonic joints. There is a fundamental unity of elementary structure and composition (as no one better knows than my reviewer) of all living beings; and animal and plant may alike be traced to, and have their origin in, the simple cell. Embryologically, therefore, all animals may be said to be alike, and in making our classificatory distinctions we necessarily refer to the perfected or ultimate structures.

(4) Mr. Riley also takes a back step in classification in separating the Strepsiptera from the Coleoptera, the fleas from the Diptera and the Thysanoptera from the Hemiptera. (5) It is strange if over thirty years of observation should not enable us to advance beyond Westwood's classification, admirable in 1840, but in many respects obsolete in 1873. (6) Again, our author states that embryological data "though of great value as pointing to the derivation of insects — their homologies and relations to the past — do not always subserve the best interests of classification." We would inquire what is classification but an attempt at tracing the genealogy of animals or plants?

(4) A few quotations will, I think, best refute the charge. Speaking of the Strepsiptera I distinctly say "now classed with the *Coleoptera*;" speaking of the Aphaniptera I say "now placed with the *Diptera* (5th Rep., p. 15); speaking of the Thysanoptera I distinctly state that they "may be placed with the *Pseudo-neuroptera*, though bearing strong relations to the *Hemiptera* (*ibid.*, p. 16); and I finally conclude my consideration of these osculant groups with the following sentence:—"As already stated, if separated from the other orders, these abnormal groups should, at the most, be considered as Suborders; and in reality they differ no more from the orders to which they are here referred than, for instance, the bark lice (*Coccidæ*) do from the more typical *Homoptera* from which no one thinks of separating them" (*ibid.*, p. 16).

(5) This stricture was doubtless inspired by the following quotation from that part of my Report which refers to the different systems of classification, and which I quote because it helps me to answer both the fifth and sixth strictures. "Remembering that classifications are but means to an end — appliances to facil-

itate our thought and study; and that, to use Spencer's words, 'we cannot, by any logical dichotomies, accurately express relations which, in nature, graduate into each other insensibly,' the difference of opinion becomes intelligible; and for my part I adopt that system which appears most natural, and which best promotes the object in view. It is essentially that of Westwood, given in his 'Introduction,' which has justly been called the entomologist's bible." Perhaps this language conveys the idea that I believe we have made no advance beyond Westwood's classification; but if so, it belies my meaning, and I have simply been unfortunate in expression! And as facts never become obsolete, and the "Introduction" referred to contains more facts, and fewer theories and speculations than many later published entomological works, I do not think it undeserving the homage paid to it, though it be "in many respects obsolete in 1873."

(6) I have already answered the inquiry, in my feeble way, in the above extract: and as to my opinion of the value of embryological data in classification, I shall content myself, at present, with adducing in its support the opinion of one who is infinitely better qualified to form an opinion which has weight. After referring in his last annual address, before the London Entomological Society, to Packard's "Memoir on the Embryology of Chrysopa, and its Bearings on the Classification of the Neuroptera," and to the opinions arrived at by the author, Westwood concludes as follows:—"And thus the position of the animal in the ovum is allowed to unite into one group *Libellula* with its active, and *Hemerobius* with its necromorphous pupa; and to separate widely *Hemerobius* and *Phryganea*, both with inactive pupa, which are, however, furnished with jaws of a structure, *per se*, for biting a hole in the cocoon before arriving at the fully-developed imago state. I confess that this specimen of classification founded upon embryological data does not carry to my mind conviction of its superior worth."

The accompanying figure (117) represents the male of the apple bark louse, which Riley calls *Mytilaspis pomicorticis*, regarding it as distinct from the *A. pomorum* Bouché of Europe, from the fact that the eggs of the European species are reddish-brown, while those of our species are white. Care should here be taken in ascertaining how soon after being laid the eggs are observed, as they may vary in color with the age of the embryo within. Certainly we have been unable to detect any difference between the bark louse of the apple as we have observed it in Jena, Germany, and

our species, having compared numerous specimens of both. Undoubtedly our species has been imported from Europe, and it would have been the better way, we think, to regard our species as identical with the *M. pomorum* (Bouché) than to give it a new name.

Now this is not very consoling after having devoted nearly three pages to the reasons for the course pursued, in which pages every point made in the above extract is carefully met and effectually broken. It is all the less so that my reviewer has himself named species on very unsatisfactory grounds.* I have studied *Mytilaspis pomicorticis* for many years, and emphasized the fact that its eggs are never, at any stage of development, reddish-brown, and that the color of the egg is a most important character in distinguishing the closely allied *Coccidæ*. I expressly stated my belief that the European insect mentioned by Curtis, Boissduval, Taschenberg and others is identical with our's, and showed that in Europe as well as in this country it had generally been considered as Gmelin's *conchiformis* which, however, applies to a similar species found on the elm in Europe, and not to the apple tree species under consideration. No one, until last year, even so much as thought of referring our insect to Bouché's *pomorum* to which, indeed, it cannot be referred; and I regret that my views and the reasons for them are not better represented in the above-quoted stricture.

The truth is, that if, following the highest authority, we consider several very closely allied forms of *Mytilaspis* as specifically distinct, the European apple tree species with white eggs, which is the one imported into this country, was, up to the appearance of my last Report, erroneously referred to *conchiformis* Gmelin; and they either have a closely allied species in Europe, with reddish-brown eggs, or else Bouché's description is so false in one

*The orange suffers greatly from the attacks of scale insects, and, among others, of a species of *Mytilaspis* so closely allied to *M. pomicorticis* that no distinguishing features have yet been pointed out. The fruit which comes to the St. Louis market is often covered with the scales, and Capt. E. H. Beebe, of Geneva, Ill., last spring sent me oranges so badly infested that the scales were two and three deep; some being broad and others more linear as is the case with all the allied species. As far back as 1850 M. Ch. Delacour, in an essay on insects which attack fruit trees, considered it identical with the apple tree species, and I am unable to find any specific differences at all reliable in the dead insects. The only way in which it can be properly separated from *pomicorticis* is by critical comparison of the living males and females of both. In the Patent Office Report for 1855, Mr. Glover gave an account of this orange species and of its introduction into Florida, but without naming it. From his imperfect figures and without giving any characters of specific value, Mr. Packard (Guide, etc. p. 527) makes two new species, viz., *Aspidiotus Gloverii* and *A. citricola*.

of the most important characters that it is valueless, and should be ignored as, indeed, it always has been. In either case, the American pomologist will appreciate more kindly than my reviewer the efforts to "brush away the cobwebs of uncertainty which have gathered around the nomenclature of the insect," and to couple an appropriate name with a description and history which cannot in future be misunderstood.

Praying your indulgence for the length of this defence, I thank you, Messrs. editors, for the appreciation otherwise manifest in the review in question.—C. V. RILEY, *Dec. 3, 1873.*

[I should not feel called upon to notice Mr. Riley's reply to my criticism, were not the views on morphology he here reiterates in my opinion so erroneous. In reply to his section 1, I may say that the reader is referred to p. 19 of the third edition of the "Guide to the Study of Insects" for my reasons for changing my opinions as to the *number* of segments in the head of six-footed insects, and on p. 18, will be found an account of the opinions of the best authors as to the composition of the head of insects. The whole matter was settled by Savigny in 1816, and confirmed by Audouin, MacLeay, Kirby, Carus, Straus-Durckheim, Newman, Newport, Huxley and others, and by every writer on the embryology of insects. If Mr. Riley, after reading the views of these authors, and studying for himself the embryology of some insect, is content to reiterate his own and Dr. Schaum's views so confidently, I shall admire his hardihood.

2. The article of Dr. Schaum is really based on such ignorance of morphology and embryology, and is so unphilosophical in its spirit, that I wonder any one can be found to endorse it. That "what is generally mistaken for the first abdominal joint" is that joint was shown to be so by Latreille, Newman and others, and I may be pardoned for saying that I believe I have proved it by an examination of the segment in question in the larval and pupal stages of the humble bee.*

3. That the head of an insect is composed of more than one segment is simply a matter of fact; there is nothing "ideal" about it. The simple fact that the head of an insect bears four pairs of jointed appendages (*i. e.* the antennæ, mandibles, and two pairs of

* See observations on the Development and position of the Hymenoptera, etc. Proceedings Boston Society of Natural History, 1866, vol. x, p. 279, and "Guide to the Study of Insects," p. 66.

maxillæ) indicates that it must be composed of four segments, while an examination of the head of an adult insect indicates that all the different pieces composing it cannot be referred to a single segment. Would it not be better in a "popular work" to tell the truth of the matter, and thus lead the reader to take an interest in the study of the morphology of insects, that highest department of biology, than to lead him blind-fold past some of the grandest truths in science?

4. My good friend is quite wrong in intimating that those larvæ which have heads "without the slightest trace of a division into subjoints," and are "blind or even destitute of antennæ," never had cephalic segments. If he will study Weismann's famous work on the embryology of insects, he will see that in the embryo of the flesh fly, the four segments and appendages are as distinct as in the embryo of the bee, *Hydrophilus*, or other beetles. The appendages become obsolete, though not wholly so, just before hatching, and Mr. Riley will probably agree with me that the differences between a "headless" maggot and a caterpillar or bee larva are probably due to differences in their mode of life. The organs are all there at the outset, in the embryo. I think Mr. Riley will set a higher value on "embryological data," after perusing the works of Rathke, Herold, Kölliker, Zaddach, Leuckart, Huxley, Claparède, and especially Weismann and Kowalevsky.

Whether my criticism on the matter of the apple bark louse was hasty and incorrect I leave to others to decide.—A. S. PACKARD, JR.]

A NEW NORTH AMERICAN BIRD.—On the 5th of July last Ludovic Kumlien, a son of Thure Kumlien, the well known ornithologist of Wisconsin, shot on Lake Koshkonong, in the central part of southern Wisconsin among a flock of the *Hydrochelidon fissipes*, a bird which he at once recognized as something entirely new to our fauna. It was a mature female and was found to contain well developed ova, though not fully grown. Mr. Kumlien, Sr., who is familiar with European forms, at once recognized it as the *Hydrochelidon leucoptera* and this determination has since been confirmed by Prof. Baird.

The *H. leucoptera* is a well known European form more common to southern Europe than farther north and has never before been known to occur on this continent. That one should be found

so far in the interior of Wisconsin, a thousand miles from the coast, is somewhat remarkable, and naturally suggests the idea that this species may be found not so very rare, but that it may occur elsewhere and have been mistaken for *fissipes*, which is a cosmopolitan bird, and is found both in America and Europe. Its principal difference from the *fissipes*, consists in its white tail, and it will be well for naturalists in various parts of the country to be on the lookout for a white-tailed tern.—T. M. BREWER.

P. S. Mr. Robert Ridgway has kindly made the accompanying description of this new acquisition to our fauna:—

Wing, 7.50; tail, 2.90; culmen, .90; tarsus, .75; middle toe, .65. Head, neck and lower parts to the anus, including the lining of the wings, uniform plumbeous-black; anal region, crissum, and upper tail coverts, immaculate snowy white; tail white, tinged with ashy. Mantle dark plumbeous, shading insensibly into the black of the nape; wings lighter, more hoary, plumbeous, becoming gradually white at the anterior border of the lesser covert region; primaries like the mantle, but more hoary, their shafts pure white. Bill, purplish black, the lower mandible more reddish; legs and feet deep orange-red.

This specimen is very similar to a European one in the Smithsonian Collection, but differs in having the upper tail-coverts and tail much purer white.

ECONOMIC ENTOMOLOGY.—Dr. LeConte's excellent paper, on "Hints for the Promotion of Economic Entomology in the United States," will be read with much interest, and do great good. The call for the expansion and reorganization of the Department of Agriculture is opportune and meets a similar and constantly increasing demand for such a reorganization from the agriculturists of the country and especially of the west. The few real farmers, sprinkled with the mass of lawyers, politicians, merchants and professional men, who go to make up the bodies composing our state and national legislatures, seem to have had little voice in the past, in the filling of offices created ostensibly for their benefit.

It is a burning disgrace that the agricultural interests of the country, which form the basis of our national prosperity, should have been represented in the seat of government by an untutored market-gardener like Isaac Newton; or should still be represented by one who is so little in sympathy with the progressive agricultural spirit, and who seems to give so much dissatisfaction, that hardly an agricultural journal in the land speaks a word in his favor. With a man at the head of this department, possessing large culture and scientific attainment, like Dr. LeConte, or extensive agricultural knowledge and great executive ability, like

W. C. Flagg, J. P. Reynolds or H. D. Emery of Illinois; or experience and popularity, like C. R. Dodge or Wm. Saunders (both at present connected therewith), there can be no doubt that it would be infinitely more efficient in promoting the interests for which it was created, and less open to criticism.

The agricultural interests of the country demand more attention and better representation. If our merchants lost one tithe of what our farmers annually lose from insect depredations alone, they would immediately seek and undoubtedly obtain adequate protection from the government; for the simple reason that they are organized and work as one body. The farmers, heretofore, have been disconnected—a mere rope of sand, without concerted plan or object. But at present they are building up a powerful organization which is rapidly extending its strengthening and unifying arms over the whole country. It is an organization which, if not perverted from its original aims, will soon become a very powerful lever in the promotion of the agricultural interests. May we not hope that through its instrumentality the plans and suggestions made by Dr. LeConte will at no distant day be realized!

In measures five and six (vol. vii, p. 722) as propounded in the paper, for the wholesale destruction of noxious insects, I have little confidence. Fires, lights, vessels of attractive or poisonous liquids are constantly recommended as means of counteracting the work of injurious insects; but my experience with them has been very unsatisfactory. Usually quite as many beneficial as injurious species, and very seldom any really injurious species, are thus captured; and at the best such measures are blind and inefficient ways of effecting that which can be otherwise effected with more certainty and satisfaction.—C. V. RILEY.

GEOLOGY.

REMAINS OF LAND PLANTS IN THE LOWER SILURIAN.—M. Lesquereux contributes an article to the "American Journal of Science and Arts" for Jan., 1874, in which he reports the discovery near Lebanon, Ohio, of fragments of *Sigillaria* in clay beds positively referrible to the Cincinnati group of the Lower Silurian. This is a remarkable discovery, as no land plants before this had been found lower down than the Lower Helderberg division of the

upper Silurian in Gaspé, Canada. In Europe no land plant has yet been found below the Lower Devonian.

MICROSCOPY.

EMBEDDING TISSUES FOR SECTION. — Dr. William Rutherford, of King's College, London, prefers to embed tissue, which is to be cut without freezing, in a mixture of paraffine (5 parts) and hog's lard (1 part) melted together; this mixture melting at a lower temperature than the wax and oil mixture, and being less liable to become loose by shrinkage in cooling. Tissues that require freezing are to be embedded and frozen in a solution of gum arabic (5 oz.) in water (10 oz.) and spirits of camphor (2 dr.), which, when solidified by cold, slices "as easily as a piece of cheese." Dr. Rutherford's microtome consists essentially of a cylinder with a piston moved by a screw, the upper portion only of the cylinder, where the object is, being surrounded by a box to contain the freezing mixture, of powdered ice and salt; the freezing box is surrounded by flannel, and the water continually forming in it is drained off by a tube through the bottom of the box.

DISSECTING EMBRYOS. — W. K. Parker, Esq., late president of the Royal Microscopical Society, dissects early embryos under water, pinning them upon a cake composed of lamp-black and paraffine.

NOTES.

THE MEMORIAL TO AGASSIZ bids fair to be of such a character as will be gratifying to his family and most appropriate in showing an appreciation of his work. At a public meeting held in Boston on Feb. 13, a large number of gentlemen were present and it was decided that the fittest expression of gratitude for Agassiz' labors for science in this country, would be to insure the maintenance of the Museum which he worked so long and so faithfully to establish for the benefit of the country. It was agreed that at least \$300,000 should be raised by subscription as a memorial fund for the purpose of endowing the Museum of Comparative Zoology in Cambridge. A large number of gentlemen, residing in various parts of the country, were named as a nucleus of a general committee for the purpose, as it was believed that the many friends to science all over the land, appreciating the worth

of Agassiz, would be glad to aid in placing his Museum on a permanent basis. The feeling has been so general and of such spontaneous growth, that a memorial of this kind would be the only appropriate one for the present. We have not the least doubt but that the sum proposed will be at once obtained and we have heard that about \$70,000 were subscribed the day of the meeting. Let all who respected the great naturalist, and who feel that science and education have been advanced by his efforts in their behalf, give each according to his means, and let us hope that from the many offerings of grateful hearts the memorial fund will soon be far larger than the sum named. Well knowing the immense expense of maintaining such a Museum, we trust that the Agassiz Memorial fund will not be allowed to stop at the comparatively small amount proposed.

In the reorganization of the Museum of Comparative Zoology, made necessary by the decease of Professor Agassiz, the Trustees have wisely secured the separation of the curatorship from that of the Lawrence Professorship of Zoology and Geology, and abolished the office of Director. As now organized the two executive officers of the museum are Mr. ALEXANDER AGASSIZ, *Curator*, and M. L. F. DE POURTALES, *Keeper*. Mr. Agassiz has also been elected by the Legislature to succeed his father as a trustee of the museum.

BOOKS RECEIVED.

- The two Principal Groups of Urbicola (Hesperidae Auct.)* By Samuel H. Scudder. 8vo, pp. 2. Dec. 19, 1873.
- Note on the species of Glaucopsyche from Eastern North America.* By Samuel H. Scudder. 8vo, pp. 2. Dec. 26, 1873.
- Bulletin of the U. S. Geological and Geographical Survey of the Territories.* No. 1. 8vo, pp. 28. Washington, 1874.
- Proceedings of the California Academy of Sciences.* 8vo, vol. v, Pt. 2. San Francisco, Jan. 1874. Vol. I, 1854-1857, second edition. Dec., 1873.
- Notes on the Drift Soils of Minnesota.* By N. H. Winchell. 8vo, pp. 8. (From Fourth Annual Report of the Commissioner of Statistics of Minnesota.) Saint Paul, 1873.
- Milk: its typical relations, a lecture delivered before the Vermont Dairymen's Association.* By E. Lewis Sturtevant. 8vo, pp. 20. South Framingham, 1874.
- Proceedings of the Boston Society of Natural History.* Vol. xvi, Pt. 1. May-June, 1873. Boston.
- Catalogue of the Phanogamous and Aerogenous Plants of Suffolk County, Long Island.* By E. S. Miller and H. W. Young. 8vo, pp. 15. Port Jefferson, L. I., 1874.
- Annals of the Lyceum of Natural History of New York.* Vol. x, nos. 6-9. Mar. 1872-Feb. 1873. New York.
- Descriptions of new Plants from the Pacific States.* 8vo, pp. 27. (From Proc. Cal. Acad. Sci., Feb. 3, 1873.)
- The Birth of Chemistry.* (Nature series). By G. F. Rodwell. 12mo, pp. 135. 24 Woodcuts. London, 1874. Macmillan & Co.
- An Essay on the Glacial Epoch.* By Phillip Harvey. (Read before the Teachers' Institute of Des Moines County, Aug. 21, 1873.) 8vo, pp. 24. Burlington.
- Bullettina della Società Entomologica Italiana.* 8vo, Anno Quinto, Trimestre, 1-3 Firenze, 1873.
- Account of the Operations of the Great Trigonometrical Survey of India.* Vol. I. *The Standards of Measure and the Base-lines, also an Introductory Account of the Early Operations of the Survey during the period 1800-1830.* By J. T. Walker, Superintendent of the survey. 4to, pp. 492. Plates 33. Dehra Doon, 1870.

